# Access, utilization, and outcomes of physical therapy services among injured workers with back pain in Washington State

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# ABSTRACT

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Back pain is a complex and multidimensional health problem that is highly prevalent and costly for the working population and society. It is one of the leading causes of disability in the US adult population and the primary reason to file a workers' compensation (WC) claim. Clinical guidelines recommend use of physical therapy (PT) services, which include active interventions, passive modalities, and manual therapy services as first-line treatments over pain medications and surgical procedures for patients experiencing back pain. While evidence suggests that patients with back pain who receive early and active PT interventions experience greater improvements in disability, pain intensity, and functional status, patients do not always receive recommended PT treatments and the variability in PT care may potentially lead to varied outcomes. Furthermore, patients living in rural areas experience greater barriers of access to medical providers including PT providers compared to their urban counterparts and the factors associated with receiving PT services remain unclear in the working population. Knowledge

about the factors associated with PT use and non-use as well as the associations between various measures of access to PT services in rural and urban areas will assist policy makers, health care providers, and researchers  in characterizing and better understand why workers are more likely to see a PT provider or not. These results may be used in addressing potential health disparities that may exist at the worker or systematic level that may impede timely and accessible PT care.

This dissertation, which covers three specific research aims, uses administrative claims, medical billing, and provider data from the WA Department of Labor and Industries Workers Compensation System (L&I WC) to examine WA state population trends in access, utilization, and outcomes of PT services among injured workers with back pain. In Chapter 2, we conducted descriptive analyses of L&I WC data from 2016 to 2019 to examine the variation in travel distance to the nearest PT provider and timing to PT services by rural and urban areas. In Chapter 3,  we performed bivariate and multivariate logistic regression models to investigate factors that may be associated with PT use and non-use from a cohort of injured workers with back pain using data from the Disability Risk Identification Study Cohort (D-RISC), which combines L&I WC administrative claims data with self-reported information on worker characteristics including socio-demographic, pain and function, psychosocial, clinical, health behaviors and employment-related factors. In Chapter 4, we conducted linear and logistic regression models to test the associations between intensity of PT services in the first 4 weeks after injury on work disability and self-reported measures for work status, pain intensity, and function scores at 1-year follow-up for injured workers with back pain using data from the D-RISC study.

In summary, this dissertation presents the methodology conducted for three specific aims and the research findings associated with each of these studies. First, we examine the variation in access to PT services for injured workers with back pain living in rural versus urban areas. Secondly, we identified factors associated with PT use and non-use. And lastly, we investigate the impact of intensity of PT services on work and health outcomes among injured workers with back pain in WA. Demonstrating these differences in access, utilization, and outcomes of PT services has the potential to transform current approaches by informing key stakeholders including medical providers, policymakers, educators, researchers, and the working population. The findings from this dissertation may also improve clinical care coordination, pain management efforts, and return-to-work (RTW) prospects for WA workers experiencing back pain.

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Brian Chin

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# CHAPTER 1: INTRODUCTION

## A. SUMMARY

This dissertation addresses the multi-dimensional issue of back pain, which poses a significant health and economic challenge for both workers and society. Through this research, I highlight the importance of back pain as a leading cause of work-related disability and a primary driver for filing a WC claim in the United States (US). Although clinical guidelines recommend PT services as first-line treatment for back pain, little is known about whether PT guidelines are followed or if workers follow recommended PT guidance. Additionally, the variability in PT care for managing back pain in workers may lead to mixed results, potentially creating greater health disparities among workers who reside in rural areas where there is a shortage of providers compared to urban areas. This research uses data from the Washington State Department of Labor and Industries (WA L&I) Workers' Compensation (WC) system to investigate our three research aims that examine access, utilization, and outcomes of PT services for workers with back pain. The three research aims are discussed within Chapters 2-4 of this dissertation. Our three research aims are as follows: 1) examining variation in access to PT care by rural versus urban area, 2) identifying factors influencing PT use and non-use, and 3) assessing the impact of the intensity of PT services on work and health outcomes. The findings of this dissertation have the potential to enhance the understanding of PT utilization and its effect on health outcomes by improving approaches for managing back pain among the working population through clinical care coordination, pain management, and return-to-work (RTW) strategies for workers with back pain in WA.

## B. BACKGROUND

Back pain is a complex and multi-faceted health problem, affecting a significant portion of the working population and placing a substantial burden on both individuals and society.[1,2] It is the second most common cause of disability in the US adult population and the primary driver of a WC claim.[1-4] Within the US, around 18-26% of workers encounter episodes of low back pain (LBP) annually, leading to a staggering loss of over 100 million workdays.[1,2] Although most individuals with acute LBP are expected to recover within four weeks of onset,[5,6] roughly 4-10% of these individuals develop chronic LBP, a medical condition that may lead to long-term disability and possibly greater health care needs.[7,8]

The extent of clinical and economic burden is significant. In a National Health Interview Survey (NHIS) of US adults, 26% of respondents reported having LBP lasting a whole day in the past 3 months[9] and the proportion of all physician visits attributable to LBP was between 2-3%.[9,10] In the US, patients with musculoskeletal disorders incur total annual health care costs of approximately $240 billion dollars, of which $86 to $100 billion dollars per year were estimated to be associated with LBP.[11-13] Specifically, two-thirds of these LBP costs were due to lost wages and reduced productivity.[11,14] Studies found that increased use of certain billable procedures and treatments including magnetic resonance imaging (MRI), opioid prescriptions, and surgical procedures for patients with LBP greatly contributed to the overall increase in health care expenditures and length of disability duration.[14-17]

Studies have also shown that non-adherence to clinical guidelines (i.e., use of early MRI for acute LBP and early opioid use for chronic LBP) results in higher subsequent health care utilization, higher costs, and longer duration of work disability.[6,18-24] More specifically, a prospective study of workers with acute LBP showed that non-adherent guideline use of early MRI was associated with increased use of lumbosacral injections, surgical procedures, and rehabilitation services compared to guideline-adherent users of MRI at 1 year after injury.[21] Another study found that one-third of workers with back injuries who received an early opioid prescription within 6 weeks of injury and those who received opioids for more than 7 days or had more than one opioid prescription were associated with being work disabled at 1-year after injury.[20] The findings of these studies highlight the important role that non-adherence to clinical guidelines when treating patients experiencing back pain may result in greater use of health care services and lead to worse health outcomes. These studies conclude that guideline-recommended rehabilitative interventions should be considered as first-line treatments over pain medications and surgical procedures for workers with back pain.[6,25]

In order to enhance the long-term outcomes for individuals experiencing LBP, clinical guidelines recommend prioritizing early use of non-pharmacological and non-invasive treatments over prescription pain medication, specifically during the initial phase of acute and sub-acute LBP.[6,24,25] One common clinical treatment for LBP is PT services, which has proven to be effective in restoring and maintaining physical function and quality of life.[6,25-31] PT services include active interventions like therapeutic exercises and activity training, which are often the preferred intervention over manual therapy and passive modalities including massage therapy, electrical stimulation, ice and heat therapies, and ultrasound.[6,25,32] Despite the clinical recommendation for early and active PT interventions for treating LBP cases,[6,25] there remains a lack of scientific research that examines the associations between the intensity and timing of PT services on work and health outcomes among workers with LBP. Additionally, a gap of knowledge exists that explores the associations between worker characteristics and other factors with PT use and non-use among injured workers with LBP. There are also very few studies that have investigated whether variation in access to PT care exists by rural and urban areas. Findings presented in this dissertation are likely to contribute to existing health disparities, PT, and occupational health literature by identifying potential barriers of access to PT services in WA, and to inform clinical practice by better understanding how to improve health and work outcomes for injured workers.

## Access to PT services

Access to PT services among workers with back pain living in rural compared to urban areas is a topic area that is not well understood.[33] Rural areas tend to have fewer health care facilities, medical providers, and specialty care services compared to urban areas[34] and individuals residing in rural areas are likely to experience lengthier travel distance to a provider's office and delays to receive medical and health services.[34-39]

## Multi-dimensional Impact of Rurality on Health Services Access

Generally, the term rurality has been defined as an area of low population density, agricultural landscapes, and area of remoteness or isolation;[38] however, this definition has evolved in recent years to incorporate aspects of community demographics, migration patterns, cultural changes, and economic conditions, which influence the distribution of resources and access to health services in rural and urban areas.[38,40] Research has shown that travel distance to medical providers,[41] timing to medical services[34,41], and provider availability[34] are common barriers of access to health services in rural areas. Patients living in rural areas experience greater transportation costs,[42] lengthier travel distances,[41-43] and longer travel time to a health care provider,[41-43] which may lead to delayed patient care. Patient accommodations including challenges with scheduling a provider visit, a limited window for hours of operation, and longer wait times to see a provider are factors that result in a delayed medical appointment.[44] Studies have also shown that transportation barriers such as having no vehicle access, inadequate public transportation, walking distance, or having no usual source of transportation[41-43,45,46] can cause delays in receiving health services. Other common factors that lead to delayed medical care include a lack of health insurance coverage[44] and lack of care coordination between providers (e.g., timing of referral).[47]

Compared to urban areas, rural areas are prone to have fewer medical providers and specialty care services[34] and studies have found that when comparing supply of providers, there was a higher prevalence of physician assistants and nurse practitioners working in rural areas compared to primary care physicians and medical specialists.[39] To highlight the shortage in provider supply, rural areas had smaller provider-to-population ratios, which were found to be associated with poorer health outcomes compared to their urban counterparts.[48] Furthermore, there appears to be a relationship between provider supply and health outcomes. In a study of registered nurses (RNs) and primary care physicians (PCPs), researchers found that areas with the highest RN-to-population ratios and PCP-to-population ratios were associated with fewer years of potential life lost, lower rates of poor or fair health, fewer teen births, and greater mammography screening in patients receiving medical care compared to areas with the lowest provider-to-populations ratios.[48] This finding was most significant in the smallest rural counties compared to larger counties and showcases the impact that the limited supply of clinical providers has on the health outcomes of the population it serves primarily in rural areas .[48]

Moreover, studies have also suggested that rural residents are more likely to be older, poorer, uninsured and have a greater risk of injury compared to urban residents.[35-38] Even though research indicates that rural patients are more likely to have greater levels of disability, experience mental health issues (e.g., depression), and have fewer provider visits compared to their urban counterparts, there is a plethora of other sociodemographic and work-related factors such as job security, educational attainment, and income levels that may also influence how patients choose and obtain health services in rural areas, which need further exploration.[36]

Studies have also shown that patients with back injuries residing in rural areas are more likely to have lengthier travel distances and fewer visits to physicians, specialty clinics, and PT providers.[49-51] Evidence of these differences between rural and urban areas is even greater among minorities living in rural areas.[36] For example, rural blacks are less likely to receive PT services from PT providers compared to urban blacks[51]. These differences may be explained by possible PT provider shortages[52] or barriers of access to PT services in rural areas.[49,50]

## Factors associated with PT Utilization

Studies have shown that demographic, health behavioral, clinical, and environmental factors are associated with higher PT use.[32,53,54] Researchers found that factors associated with PT use include female sex, older age, higher socioeconomic status, residence in an urban area, increased social networks, poor self-rated health status, higher pain intensity, poorer functional status, and living with a severe or chronic condition.[32,53,54] Although studies have shown the associations between chronic LBP and work-related and psychosocial factors;[55-57] no research to my knowledge has been conducted to examine the associations between PT use and non-use with work-related and psychosocial factors. Identifying worker characteristics and other factors that are associated with PT use and non-use can provide additional support for understanding potential health disparities in access to PT services and the impact that it may have on work disability and self-reported measures for work status, pain intensity, and functional status scores for injured workers with back pain.

## Physical Therapy Care as a Rehabilitative Strategy for Back Pain

PT care consists of multiple types of PT interventions (e.g., active interventions, passive modalities, and manual therapy) conducted at varying frequencies over the entire duration of patient care. To manage back pain, PT providers customize treatment plans for each patient through a combination of varying amounts and types of PT interventions tailored to individual health care needs and recovery expectations. Despite the complexity of standardizing PT care, researchers have investigated PT utilization as one of many possible measures for quantifying PT care. Some ways that PT utilization have been examined is by the amount (volume) and type of PT services,[58,59] adherence to PT guidelines,[60-62] and timing to PT services.[61,63-67]

## Physical Therapy Use as a Measure for Physical Therapy Care

In a prospective study of older adults with back and leg pain, PT care was defined as the total amount (number of PT visits) and type (active, passive, or manual therapy) of PT interventions using Current Procedural Terminology (CPT) codes.[58] This study found that greater amounts of active PT interventions were associated with improvement in pain intensity, but no differences existed between disability outcomes and the amount and the type of PT interventions.[58] Furthermore, a retrospective study of injured workers with knee pain examined the associations between the duration of work disability and combinations of amount (no PT, low PT, high PT) and type (active, exercise, and passive modalities) of PT services post-surgery.[59] Results of this study demonstrated that greater amount of passive PT interventions was associated with longer duration of disability and that there was no difference in the length of disability between users of active PT and non-users of PT interventions.[59]

### Physical Therapy Guideline Adherence as a Measure for Physical Therapy Utilization

PT guidelines for LBP recommend an active regimen including trunk strengthening and coordination, endurance exercises, activity training, and repeated movements over passive PT and manual therapy treatments.[68] Additionally, PT guidelines recommend education and counseling sessions that promote the patient's spinal strength, pain perception, early resumption of normal activities, and pain coping strategies that reduce psychosocial stressors including fear and catastrophizing.[68] Research shows that adherence to guideline-recommended early and active PT treatments is associated with improvement in disability outcomes and a reduction in health care utilization and total costs[60-62]; however, continual use of active interventions provided no additional benefit for patients who are expected to have improved outcomes.[69]

### Timing to Physical Therapy Services as a Measure for Physical Therapy Utilization

Evidence suggests that individuals with acute LBP who receive early referral and timing to PT services experience improvements in pain intensity and functional status as well as have reduced health care utilization and costs compared to individuals receiving delayed or no PT treatments.[61,64-66,70] Specifically, patients with back pain receiving early PT services are less likely to receive lumbosacral injections,[61,63,67] lumbar surgery,[61,63,67] advanced MRI,[61,63,70] opioid prescriptions,[61,63,70] and physician office visits,[61,63,67] which resulted in shorter duration of disability[64,66] and lower health care costs.[61,63,70] Moreover, patients with back pain who receive a combination of early and active PT interventions experience greater improvements in pain and function measures;[39-41,43-44] however, patients did not always receive recommended PT treatments[67] or experience any differences in outcomes from PT services,[65] which highlights the importance for examining the quality and best practices of PT care.

### Rising Prevalence of Chronic Low Back Pain in the United States

In one state-based household survey from 1992 to 2006, the prevalence of chronic LBP increased from 3.9% to 10.2%[8] and a 2009 national survey estimated a value as high as 13.1%.[71] Additionally, national and state-based population studies found that less than a third of chronic LBP patients sought a PT provider within the first year of injury and that there was little to no change in PT usage from 1997 to 2006 for individuals with back pain.[7,12,72] Although it remains unclear if guideline-adherent (i.e., early and active) PT interventions result in better health outcomes for injured workers with chronic LBP, it is evident that patients with chronic low back pain are more likely to have long-term disability and use more health care services.[8] Therefore, it is necessary to investigate other individual and area-level factors (e.g., the impact of rurality on access to PT services and predictors of PT use) that explain long-term disability and use of PT services.

## C. RESEARCH AIMS

### SUMMARY

This dissertation explores three research aims, which uses administrative claims, medical billing, and provider data from the WA L&I WC system to examine access, utilization, and outcomes of PT services among injured workers with back pain. In Chapter 2, descriptive analyses of L&I WC data from 2016-2019 were conducted to examine the variation in travel distance to the nearest PT provider and timing to PT services by rural and urban areas. In Chapter 3, bivariate and multivariate logistic regression models were conducted to investigate factors associated with PT use from a cohort of injured workers with back pain using data from the D-RISC, which includes self-reported information on worker characteristics including socio-demographic, pain and function, psychosocial, clinical, health behaviors and employment-related factors. In Chapter 4, linear and logistic regression models were conducted to test the associations between intensity of PT services in the first 4 weeks after injury on work disability and self-reported work status, pain intensity, and function scores at 1 year after injury date for injured workers with back pain using data from D-RISC.

### Specific Aim 1: **Examine variation in access to PT services among workers with back pain in Washington State between rural and urban areas.**

Access to PT services will be measured in two ways: 1) travel distance (in miles) between injured worker's home residence and the nearest PT provider; 2) time (in total days) between injury date and the date of first PT visit. In addition to these two access to PT measures, we examined the association between a third measure of PT access, back-injured worker-to-PT provider ratio, by rural and urban area in each of WA's 39 counties, which can be found in Appendix A. We hypothesize that workers with back pain residing in rural areas will travel further to receive care from a PT provider and have longer time to their first PT visit compared to workers residing in urban areas.

### Specific Aim 2: **Identify factors associated with PT use versus non-use among workers with back pain in Washington State**

Factors from six domains (socio-demographic, pain and function, psychosocial, clinical, health behavior, and employment-related) was identified from a prior D-RISC study that examined factors associated with work disability.[73] For Aim 2, I hypothesize that workers with higher education, higher income, chronic conditions, residence in urban areas, higher baseline pain intensity, and lower baseline function scores will be more likely to utilize PT services compared to workers without these characteristics.

Specific Aim 3: **Among workers with back pain, assess how intensity PT services are associated with work disability and self-reported work status, pain intensity and function scores at 1 year**

Test whether work disability and self-reported work status, pain and function scores assessed at 1-year follow-up differ by intensity of active PT, passive PT, and manual therapy in the first 4 weeks after injury. I hypothesize that injured workers with back pain receiving greater intensity of PT services in the first 4 weeks after injury will see improvement in their work disability outcome, be currently working, and experience a reduction in pain and function scores at 1-year follow-up compared to those with lower intensity or no use of PT services by each treatment type (i.e., active, passive, and manual therapy).

## D. CONCEPTUAL FRAMEWORK

The conceptual framework guiding this proposed research is adapted from the Andersen-Newman Behavioral Model of Health Services Use, which serves as the foundation for promoting access to health care services and reducing health disparities in the general population.[74] The Andersen-Newman Behavioral Model of Health Services Use draws upon factors (e.g., environment, demographics, socioeconomic status, health behaviors, and clinical) that emphasize access to health care services including predisposing, enabling, and need characteristics, that impact use of medical services and health outcomes.[74] Predisposing factors include sociodemographic characteristics and attitudes and beliefs about health care services, which are not commonly not directly responsible for health care use (e.g., race is typically not a reason for seeking health care), but these factors often affect health care experiences and use of health care services. Although individuals are predisposed to use of health care services, there must be some means for obtaining these services, which are represented by enabling factors. Enabling factors include individual and community-level resources, such as income level, insurance coverage, transportation needs, and supply of health care providers. Assuming the presence of predisposing and enabling factors, need characteristics, which are considered the most immediate reason for health care use, reflect the individual's perception of health services use and are often measures related to individual health (e.g., self-reported pain intensity, health status, and comorbidities).

Access to health services has been defined in multiple ways. Some researchers define access to health services as the ability to enter, reach, or visit a health care system, while others define access to health services as the relationship between consumer demand for care and the availability of health care resources.[75-77] Moreover, access to health services has evolved to describe a multilevel perspective of factors related to health care providers, health organizations, and health systems at the individual, community, and population levels.[44] In Chapter 2 of this dissertation, this multilevel perspective of access to health services is presented as two conceptual dimensions, availability and accessibility.

Availability has often been defined as the relationship between the patient's needs and the volume and type of existing health services and resources. Availability has traditionally been measured as the total number of provider types (e.g., physicians, dentists, nurse practitioners, and specialists) and provider settings (health care facilities, clinics, and hospitals) within a certain unit area and by matching the patient's health care needs to the appropriate provider's specialty[75]. Accessibility is defined as the relationship between the location of health care services and the location of patient residence. Accessibility has been measured as individual mobility needs, transportation services, travel time, and travel distance to a health service[74,75,77].

In this dissertation, we define access to PT services as a framework for measuring the availability of PT providers[75] and accessibility to PT services.[75,77] In Chapter 2, we utilize this framework to understand the variation in access to PT services by examining two access to PT measures, 1) travel distance to the nearest PT provider and 2) timing to the first PT visit (Figure 1.1). Furthermore, we developed this conceptual framework (Figure 1.2) to describe factors that may be associated with PT use and non-use for in Chapter 3 and test the associations between intensity of PT services on work and health outcomes in Chapter 4.

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## CHAPTER 2: RESARCH AIM 1

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# CHAPTER 2

Access to physical therapy services in workers with low back pain: rural-urban variation in Washington State

## A. ABSTRACT

INTRODUCTION: Accessible and timely physical therapy (PT) care is needed for treating low back pain (LBP) symptoms. However, workers residing in rural areas often face significant challenges in accessing PT services compared to their urban counterparts. The primary aim of this study was to investigate the variation in access to PT services for workers experiencing LBP in Washington State between rural and urban areas.

METHODS: We conducted a retrospective cohort study of workers with a back injury using workers' compensation (WC) claims data from the Washington State Department of Labor and Industries State Fund from 2016 to 2019. Two access measures were analyzed by rural and urban areas including travel distance to the nearest PT provider and timing to the first PT provider visit. We conducted a descriptive analysis and performed linear regression models to evaluate rural and urban differences in these measures.

FINDINGS: Among the 47,785 back injury claims, our analysis revealed that workers living in small rural and isolated small towns experienced a travel distance that was 14 miles longer to reach a PT provider. Additionally, they also encountered a longer delay of up to 19 days before their initial visit with a PT provider, in comparison to workers residing in urban areas.

CONCLUSION: Access to PT services may be influenced by various factors including availability of PT providers, transportation barriers, and administrative challenges. Understanding these challenges is essential in addressing health disparities that may exist in accessing PT care in both rural and urban communities.

KEYWORDS: physical therapy, low back pain, access to care, rural health

## B. INTRODUCTION

Low back pain (LBP) is one of the most frequently encountered symptoms in clinical practice and is the leading health problem that workers experience in the United States (US).[78,79] The estimated prevalence of LBP in the past three months among US workers is 26.4%, with 8.1% of these workers reporting that their LBP is frequent and severe.[80] While most cases of acute LBP tend to resolve without medical treatment within the first 6 weeks of injury,[5,81] cases of chronic LBP that require ongoing medical attention hinder a worker's ability to perform job duties, impede functional recovery, and reduce overall quality of life.[80,82] Recent clinical LBP guidelines recommend that non-pharmacologic and non-invasive procedures such as physical therapist (PT) services be considered for first-line treatment, which has been demonstrated to be effective at managing LBP symptoms including reduction in pain levels, improvement in functional recovery, and increased mobility.[6,83-85] Additionally, individuals who initiate early, and follow recommended, PT clinical guidelines for treatment of LBP may see greater improvement in health outcomes compared to those who receive delayed or non-guideline adherent PT care.[61,62,64,66,83,85]

Workers residing in rural areas often face significant barriers in accessing PT services compared to their urban counterparts. In rural areas, there remains an unmet demand for health care providers, health care facilities, and specialty care services for treatment of LBP and other health conditions.[41-43] Workers residing in rural areas also experience longer travel distances, lengthier commute times, and higher transportation costs to a health care provider, which pose significant challenges for workers in need of accessing evidence-based health care services including PT care.[41-43] In terms of administrative challenges, delayed referrals to PT providers, the lack of patient care coordination, problems with scheduling visits, and long appointment wait times increase the likelihood that the worker may not receive timely access to PT care.[34,41,44]

Transportation barriers also present a significant challenge for workers needing PT services in rural areas. These barriers include not having access to a vehicle, absence of a public transportation system, and limited walkability to a PT provider's office.[41-43,45,46] Rural areas also face a shortage of health care providers compared to the population that they serve, which has been associated with higher rates of poor or fair health and reduced utilization of preventative health screenings.[48]

There have been few studies that have examined the associations between access to PT services by rural and urban areas in the working population. Thus, our primary study objective is to investigate the variation in access to PT services for workers experiencing LBP in WA between urban and rural areas. We analyzed two access measures by rural and urban areas including travel distance to the nearest PT provider and the timing (in days) required to attend a first PT provider visit.

## C. METHODS

### STUDY DESIGN AND DATA SOURCE

We conducted a retrospective cohort study of workers with a back injury using workers' compensation (WC) claims data from the Washington State (WA) Department of Labor and Industries (L&I) State Fund from January 1, 2016 through December 31, 2019. The L&I State Fund provides a no-fault industrial insurance for approximately 70% of non-federal workers in WA. The remaining non-federal WA workers were covered by self-insured employers. Workers with self-insured employers were not included in this analysis due to incomplete billing data. WC data from the L&I State Fund consists of administrative claims, medical billing, and provider data that include worker-specific and provider-level information such as demographic characteristics, medical diagnoses, current procedural terminology (CPT) codes and information about the location of the worker's home residence and the provider's business address.

### STUDY POPULATION

Our study population included adult workers (age 18 years and older) residing in WA that filed a new WC claim for a back injury from 2016 to 2019 through the L&I system. We selected all WC claims with a back injury using the Bureau of Labor Statistics' Occupational Injury and Illness Classification System (OIICS) body part and nature of injury codes Version 1.01. OIICS body part codes consisted of all back regions including thoracic, lumbar, sacrum, coccyx, and multiple trunk areas excluding the neck (Appendix B). OIICS nature of injury codes consisted of various injuries to the muscle, tendon, ligaments, and joints in the back area including back strain, back sprain, bruises, inflammation, disc disorders, dorsopathies, sciatica, and lumbago (Appendix B).[73,86] We checked all claims for duplicate records and any exact matches on claim number, residential address information, and OIICS body part and nature of injury codes were removed.

### EXCLUSION CRITERIA

We excluded claims with complicated LBP, which we defined as WC claims that had a severe back condition or specific pathology including spinal infections and tumors, lumbar spine fractures, inflammatory spondyloarthropathies, osteoporosis, and developmental spinal deformities. Claims with a pregnancy-related diagnosis were also excluded. We excluded cases of complicated LBP using International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) and International Classification of Diseases, Tenth Revision, Clinical Modification (ICD-10-CM) codes (Appendix C).

### PHYSICAL THERAPY CLAIM

We defined a PT claim as a WC claim that had a PT-specific CPT code on file that was billed by a licensed PT provider or a facility (e.g., hospital, clinic) providing PT services (Appendix D). WC claims that did not meet this definition were classified as a non-PT claim. A list of PT-specific codes was constructed using the American Medical Association's CPT coding system, Health Care Common Procedure Coding System (HCPCS), and the L&I local coding system (Appendix D).

## RURAL AND URBAN COMMUTING AREA (RUCA)

We used ZIP code data provided from each worker's residential home address to define rural and urban areas by matching ZIP code information to the corresponding Rural and Urban Commuting Area (RUCA) code. RUCA code version 3.1, which consists of 33 unique RUCA codes across 10 major urban and rural categories, was utilized to account for changes in population density, commuting flow, and proximity to an urbanized area or cluster.[87] We classified urban and rural areas using a four-tiered categorical scheme. The four categories included 1) urban area, 2) large rural city or town, 3) small rural town, and 4) isolated small town. Urban area included RUCA codes: 1.0, 1.1, 2.0, 2.1, and 3.0. Large rural city or town consisted of RUCA codes: 4.0, 4.1, 4.2, 5.0, 5.1, 5.2, 6.0, and 6.1. Small rural town comprised of RUCA codes: 7.0, 7.1, 7.2, 7.3, 7.4, 8.0, 8.1, 8.2, 8.3, 8.4, 9.0, 9.1, and 9.2. Lastly, isolated small town included RUCA codes: 10.0, 10.1, 10.2, 10.3, 10.4, 10.5, and 10.6.

## ACCESS MEASURES

Our study aimed to characterize differences in the accessibility and timeliness of PT care for workers residing in urban and rural areas. To achieve this, we analyzed two access measures including the travel distance to the nearest PT provider and the timing to the first PT visit.

## TRAVEL DISTANCE TO THE NEAREST PT PROVIDER

Travel distance to the nearest PT provider was defined as the total number of driving miles between the injured worker's home residence address and the business location address of the nearest PT provider. In order to obtain the PT provider's business location address, we linked the L&I WC administrative claims dataset with the provider dataset, which contained provider-specific information about the provider type, provider specialty, and the business location address. While our primary goal was to examine WA-based PT providers, we also included PT providers from two contiguous states (Idaho and Oregon) to explore the possibility that WA workers may seek PT services that were closer in proximity to their home residence particularly if the worker lived in a town or city along state-line borders. Furthermore, we only included PT providers that had previously billed for a PT procedure within the L&I WC system during the study period time frame from 2016 to 2019. Geo-coordinates for latitude and longitude corresponding to each worker's home residence address and PT provider's business location address were used to calculate real-time travel distance by road networks to the nearest PT provider using the closest facility feature in ArcGIS version 10.5.1.[88]

## TIMING TO THE FIRST PT PROVIDER VISIT

Timing to the first PT provider visit was defined as the total number of days between the worker's injury date and the first PT visit date during the first year of injury. We restricted timing to a PT provider to the first year after injury to provide a consistent observation window for all included workers. A worker's injury and initial PT visit date was identified using L&I administrative claims and medical billing data. This measure was only calculated for workers with LBP that received PT services by a PT provider.

## DATA ANALYSIS

We performed a descriptive analysis of demographic, health-related, and occupational characteristics by rural and urban area for each worker. Univariate and bivariate analyses for each binary or categorical characteristic and rural and urban area were conducted using Pearson's Chi-Squared test. Summary statistics were generated, and we reported total counts, column percentages, mean and standard deviation for all categorical and numeric variables, respectively. Unadjusted and adjusted linear regression models were conducted to evaluate the associations between timing to first PT provider and urban and rural areas for workers who received PT services by a PT provider . For all regression models, we calculated estimates with robust standard errors and reported the proportion value with a 95% confidence interval using StataCorp SE, version 14 (College Station).[89] We calculated the shortest travel distance to the nearest PT provider's business address from each injured worker's home residence addresses using geocoded longitude (X) and latitude (Y) coordinates by road network. All variables included in the adjusted models had a minimal missing rate of 3.3% or lower, which is unlikely to meaningfully affect the results.[90,91] Additionally, we found no missing data for the injured worker's home residence and PT provider business location address for any of the two access measures.

## COVARIATES

In our unadjusted and adjusted linear regression models, we identified demographic, health-related, and occupational factors that were included as covariates in our statistical analyses (Table 2.1). These factors were selected from administrative claims, medical billing, and provider datasets. All covariates were selected *a priori* and included in our adjusted model.

## D. RESULTS

Table 2.2 presents the demographic, health-related, and occupational characteristics of WA workers with back injuries, by rural and urban categories, regardless of whether PT services were received. We found that all demographic, health-related, and occupational characteristics were significantly associated with rural and urban areas ($p$<.05). Our findings showed that compared to urban areas, rural workers were more frequently in the older age group, male, married, and worked in agriculture, forestry, fishing, and mining industries or in the natural resources, construction, and maintenance occupations. Additionally, workers residing in rural areas were more likely seen by a physician assistant or a nurse practitioner and were less likely to have a traumatic injury or multiple injury claim compared to workers residing in more urban areas.

Table 2.3 shows the distribution of demographic, health-related, and occupational characteristics for the subset of back injured workers receiving PT services, by rural and urban categories. Of the 47,785 WA workers in our study, we found that 17,632 (36.9%) of these workers received PT services within the first year of their injury date. Age group, sex, marital status, attending provider, traumatic injury, multiple injury, industry, and occupation were all significantly associated with rural and urban areas (p<0.05). Compared to workers residing in urban areas, we found that workers residing in rural areas were more likely to be in the older age group, male, married, and work in the agriculture, forestry, fishing, and mining industries and have an occupation in the natural resources, construction, and maintenance. Although physicians were one of the  most commonly seen provider groups by count across all urban and rural areas (30-49%), , our findings showed that workers were more likely seen by a physician assistant or a nurse practitioner in increasingly more rural areas compared to workers that lived in urban areas. Our results also indicated that workers residing in rural areas were less likely to have a traumatic injury or multiple injury claim compared to workers residing in more urban areas.

### Travel distance to the nearest PT provider

Table 2.4 contains the summary statistics for the worker's travel distance to a PT provider by urban and rural areas. We found that the mean distance in miles to a PT provider increases as the level of rurality increases, with workers traveling a mean distance of roughly 2.0 miles in urban areas, 3.9  miles in a large rural city or town, 15.4 miles in small rural towns, and 15.3 miles in isolated small towns. Similarly, the median travel distance in miles to a PT provider increases as the area becomes more rural.

Table 2.5 contains the results from the adjusted  linear regression models that examined distance to a PT provider in miles, by urban and rural categories. Compared to workers residing in urban areas, workers that live in increasingly more rural areas had significantly longer travel distances. Compared to workers residing in urban areas, workers that reside in large rural cities or towns had an additional 2.0 miles travel distance to a PT provider on average, while workers that live in small rural towns and isolated small towns were estimated to have an additional 13.5 and 13.3 miles of travel distance, respectively.

### Timing to the first PT provider visit

Table 2.6 presents the results from the adjusted linear regression models. We found that workers who resided in a large rural city or town, small rural town, or isolated small town had a significantly longer time to the first PT provider visit compared to workers who resided in an urban area, with the longest time to the first PT visit estimate observed in large rural cities or towns at 20 additional days compared to an urban area. Older age, seeing a chiropractor (compared to physician), or having multiple injuries were significantly associated with longer timing to a PT provider. We also found significant differences between industry and occupational groups by rural and urban categories ($p<0.05$). Our findings also suggest that the time to the first PT provider visit was shorter for workers who saw a physician assistant or nurse practitioner, had a traumatic injury claim, or worked in any other industry except agriculture, forestry, fishing, and mining (compared to the construction industry). Gender, marital status, and occupational group were not significantly associated with timing to a PT provider.

## E. DISCUSSION

The primary aim of our study was to investigate the variation in access to PT services for injured workers experiencing LBP in Washington State between rural and urban areas from 2016 to 2019. Workers residing in rural areas were more likely to have longer travel distances to a PT provider and lengthier time to first PT visit compared to workers residing in urban areas.

Our findings highlight the challenges faced by many rural communities. One key challenge is the scarcity of PT clinics and providers in these areas. Rural areas often have a limited healthcare infrastructure, with fewer clinics and providers compared to urban areas.

We found that workers with LBP residing in rural areas received PT care 16 to 20 days later after injury than a worker with LBP residing in the most urban area. This finding highlights the gap in access to PT services and suggests that many workers with LBP residing in rural areas may be unable to receive accessible and timely treatment for their LBP symptoms. Although speculative, this could potentially result in higher use of other methods of pain management or treatment such as opioids or other prescription drugs, while the worker waits for a referral to a PT care or other more invasive procedures such as back surgery in more urban areas, especially if symptoms persist into the chronic phase of injury (12+ weeks).[61,64] Investigating how access to PT care is associated with quality measure for guideline adherence and substitutions in care is an area for future studies.

Our finding regarding longer timing to a first PT provider visit in more rural areas could be related to fewer available PT providers (e.g., longer waits for an available appointment), or could also be related to transportation barriers. Transportation barriers can pose a significant challenge for workers in accessing PT services in rural areas. Rural communities often lack reliable public transportation, and workers may have to travel long distances to reach the nearest PT clinic.[41-43] This can be particularly difficult for individuals with limited mobility, lack of personal transportation, or financial constraints. The cost and logistics of traveling to PT appointments can be prohibitive for some workers, resulting in decreased utilization of needed PT services and reduced access to care. In contrast, workers in urban areas tend to have better transportation infrastructure, with more options for public transportation and shorter distances to PT clinics and providers, which can facilitate better access to care for urban residents. More research is needed to explore how transportation barriers may impact the care that is received by an injured worker, which may impact the health outcome for the worker.

Clinical challenges are exacerbated by the difficulties of recruitment and retention of licensed PT providers in rural areas due to factors such as lack of professional networks in the area limited opportunities for continuing education, and available medical equipment and infrastructure for providing PT care. As a result, the availability of PT services in rural areas may be limited, leading to reduced access of PT care for those who live in these areas. Furthermore, other factors such as health care affordability, insurance coverage, and cultural barriers can further limit access to PT services in both rural and urban areas for lower socioeconomic and minority workers. While all the workers in this study were covered by WC, more generally, rural residents may face financial challenges due to lower incomes and higher out-of-pocket expenses, as well as limited insurance coverage options. In urban areas, although PT services may be more available, affordability can still be a concern due to higher costs of living and insurance premiums. Although the focus of this study is to examine the variation in access to PT services for injured workers residing in urban and rural areas, further research is needed to better understand how other socioeconomic, work-related, and provider-level factors may continue to make accessing PT services a challenge for workers with LBP in the future.

This study has some limitations. First, our findings may not be generalizable outside of WA, because every US state jurisdiction has differing WC laws regarding treatment coverage and reimbursement plans. Another limitation was the inability to identify the specific access-related reasons for longer timing to a first PT visit, such as transportation availability, scheduling of appointments, or other administrative barriers. Strengths of the study include the population-based sample, and use of a rural classification scheme as applied to the injured worker population.

## F. CONCLUSION

In conclusion, we found that workers residing in rural areas were prone to longer travel distances to a PT provider and longer delays to their first visit with a PT provider compared to workers residing in urban areas. Variation in accessible and timely PT care remains a challenge, which can be influenced by various factors in both rural and urban areas, including availability of clinics and providers, transportation, affordability, insurance coverage, and cultural barriers. Understanding these challenges is essential in addressing the disparities in access to care and improving the availability and utilization of PT services in both rural and urban communities. Further research and targeted interventions are needed to ensure that workers in all communities have equitable access to PT services for optimal health outcomes.

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## CHAPTER 3: RESEARCH AIM 2

**Title:** Identifying factors associated with physical therapy use versus non-use among injured workers with back pain in Washington State

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# CHAPTER 3

## Identifying factors associated with physical therapy use versus non-use among injured workers with back pain in Washington State

### A. ABSTRACT

BACKGROUND: There is little information about predictors of physical therapy use among injured workers with back pain. The primary objective of this study is to investigate the associations between physical therapy use and baseline factors not routinely captured in workers' compensation data.

METHODS: We conducted a secondary analysis using the Washington State Workers' Compensation Disability Risk Identification Study Cohort, which combines self-reported surveys with claims data from the Washington State Department of Labor and Industries State Fund. Workers with an accepted or provisional workers' compensation claim for back injury between June 2002 and April 2004 were eligible. Baseline factors for physical therapy use were selected from six domains (socio-demographic, pain and function, psychosocial, clinical, health behaviors, and employment-related). The outcome was a binary measure for physical therapy use within one year of injury. Bivariate and multivariable logistic regression models were conducted to evaluate the associations between physical therapy use and baseline factors.

RESULTS: Among the 1,370 eligible study participants, we identified 673 participants (49%) who received at least one physical therapist service. Bivariate and multivariable analyses showed that baseline factors from five of the six domains (all but health behaviors) were associated with physical therapy use including gender, income, pain and function measures, injury severity rating, catastrophizing, recovery expectations, fear avoidance, mental health score, body mass index, first provider seen for injury, previous injury, and several work-related factors.

CONCLUSION: We identified baseline factors that are associated with physical therapy use, which may be useful in addressing health disparities in access to care for injured workers with back pain in a workers' compensation system.

IMPACT STATEMENT: Knowledge of factors associated with physical therapy use may assist in identifying workers who have limited access to physical therapist services and in improving clinical care for workers who experience back pain.

## B. BACKGROUND

Back pain is highly prevalent and costly for the working population and society.[1,2] It is among the leading causes of disability in the United States (US) adult population and the most frequent reason to file a workers' compensation (WC) claim.[2,92] In the US, more than a quarter (26%) of adults reported having low back pain (LBP) lasting a whole day in the past three months and, when extended to an entire lifetime, roughly 50% to 80% of the adult population will experience at least one episode of LBP.[9,93] The burden of total direct and indirect costs attributable to LBP in the US is estimated to exceed $100 billion dollars annually, of which two-thirds is due to lost wages and reduced productivity.[11,14] Additionally, an estimated 149 million work days per year are lost due to LBP.[2] While most individuals who have LBP recover within four weeks of onset,[5,6] about 26% of those individuals transition to chronic LBP after 3 to 6 months, which often contributes to long-term disability and greater health care utilization.[8,94]

Well-established LBP guidelines emphasize that conservative treatments, including physical therapist services, are recommended for improving physical function and pain management.[6,69,83,95] Several studies have examined the associations between baseline factors and the use of physical therapist services among adults with back pain.[32,53,54,96] These studies have shown that individual-level factors including older age, women, higher educational attainment, higher income, more comorbidities, greater injury severity, and greater social support were associated with higher physical therapy utilization.[32,53,54,96] Residence in urban areas and self-rated health factors such as poor health status, higher pain levels, and poor function scores were similarly associated with higher use of physical therapist services.[32,53,54] In addition, medical providers that advocated the importance of physical therapist services as part of a recovery program and encouraged at-home exercise training were more likely to see routine physical therapy use among their patients.[97] Furthermore, provider recommendations and advocacy for physical therapy exercises were also found to increase the patient's sense of self-efficacy and self-motivation to participate in home-based exercise training.[97]

While relationships between physical therapy use and individual and provider-level factors have been examined in the general adult population, there are a few studies that examine the associations between baseline factors and physical therapy use specifically among injured workers with back pain.[98,99] In a study of US workers with occupational back pain, researchers found that workers who had greater injury severity and functional limitations were more likely to be treated by a combination of medical physicians, chiropractors, and physical therapists compared to medical physicians alone.[98] Socio-demographic characteristics and work-related factors such as older age, occupational group, and employer choice of health care provider were also associated with a physical therapist visit.[98] Furthermore, a study of Canadian workers with back pain examined factors associated with first healthcare provider seen after injury, finding that a worker's age, injury severity, occupational group, and community size were associated with a physical therapist consultation.[99] More research is needed to elucidate whether other factors are associated with physical therapy use among injured workers, beyond traditional clinical care and injury severity.

Therefore, the primary objective of this study is to investigate the associations between physical therapy use among injured workers with back pain and baseline factors that are not routinely captured in WC claims data, including psychosocial and employment-related factors. Identifying factors that are associated with physical therapy use and non-use may be useful for addressing health disparities in access to physical therapy services for a working population.

## C. METHODS

### DATA SOURCE AND STUDY DESIGN

This was a secondary analysis of prospective data collected from the population-based Washington State (WA) Workers' Compensation Disability Risk Identification Study Cohort (D-RISC). The D-RISC study was conducted to identify risk factors for chronic disability among workers with a back injury.[73,86] D-RISC combines self-reported survey responses with administrative claims and medical billing data from the WA Department of Labor and Industries (L&I) State Fund, which provides no-fault industrial insurance for over two-thirds (70%) of non-federal WA workers. The remaining 30% of non-federal WA workers is covered by self-insured employers, for which data were not available for this study.

### STUDY PARTICIPANTS

A flowchart of the study population, eligibility criteria, and exclusions is presented in Figure 3.1. Workers who received wage-replacement benefits for temporary total disability (four or more days off work) in WA due to work-related injury were eligible for this study. We identified 4,354 potential D-RISC participants with an accepted or provisional (pending decision) L&I WC claim for back injury between June 2002 and April 2004, of which 2,207 could not be contacted after injury, declined enrollment, or were unable to complete the interview in English or Spanish and did not participate in this study. The remaining total of 2,147 respondents agreed to participate in the study and were reviewed for additional eligibility requirements. Based on the review, we excluded 777 additional participants because they did not complete the baseline interview in the first 6 weeks, did not receive compensation within the first year of injury, were hospitalized for injury in the first 30 days, had missing data on age, or did not have a back injury, resulting in a final study population of 1,370 participants who were included in this analysis. This study was approved by the University of Washington Institutional Review Board.

### MEASURES

Baseline factors measured at the time of the first interview for physical therapy use were selected from six domains (socio-demographic, pain and function, psychosocial, clinical, health behaviors, and employment-related), identified from previous studies (Table 3.1).[73,86] Baseline factors were collected from the self-reported interview data, with the exception of age, gender, location of worker residence, and first provider seen after injury. Industry sector information, which we retrieved from the WC claims data, was categorized into ten groups using the National Institute for Occupational Safety and Health National Occupational Research Agenda (NORA) definition (Table 3.1).[100] In addition, medical record reviews were conducted by trained occupational health nurses to provide an injury severity rating for the back injury as described by prior studies.[73,101] All baseline factors were selected *a priori* using a conceptual framework adapted from the Andersen-Newman Behavioral Model of Health Services Use, and based on findings from prior studies.[74] The outcome for the current study was a binary measure for physical therapy use (vs. no physical therapy use) within 12 months after the worker's injury date. Physical therapy use was defined as an injured worker receiving physical therapist services using billed physical therapy codes, while no physical therapy use was defined as having no such codes. The list of qualifying physical therapy codes was constructed using the American Medical Association's Current Procedural Terminology (CPT), Health Care Common Procedure Coding System (HCPCS), and the L&I local coding system (Appendix D).

### STATISTICAL ANALYSIS

We used descriptive statistics to characterize the sample. We conducted bivariate logistic regression analyses to evaluate the associations between baseline factors from each of the six survey domains and the outcome measure. We calculated unadjusted odds ratios including 95% confidence intervals and *p*-values for each variable. We then conducted a series of multivariable logistic regression models to test the associations for selected baseline factors and physical therapy use. Selected baseline factors included variables that were significantly associated with physical therapy use in the bivariate analyses or were based on findings from previous studies. These models tested each baseline factor in turn (using separate models), adjusting for the seven socio-demographic factors (age, gender, race/ethnicity, marital status, education, annual household income, and location of worker residence). All models used robust variance estimates. All statistical analyses were performed using StataCorp SE, version 15 (College Station, TX)[89] with a two-tailed significance level set at $p \leq 0.05$.

## D. RESULTS

### BASELINE FACTORS

Among the eligible study participants (N=1,370), 68% were men, 70% were white non-Hispanic/Latino, and 51% were married. The mean age for this cohort was 39.6 years old (SD=11.2). Most participants indicated having a high school education or greater (87.7%), an annual household income of $45,000 or less (66.5%), and a residence in an urban area (60.6%).

In this cohort, most participants interacted with a primary care provider (35.7%) or chiropractor (28.2%) as their first health care provider after injury. On average, at baseline, participants reported a moderate pain intensity score (mean of 5.4 out of 10, SD: 2.6), a Roland Morris Disability Questionnaire (RMDQ) disability score (mean of 12.9 out of 24, SD:6.9), and the majority had a back injury severity rating of mild sprain/strain (56.5%). Most participants were classified as either overweight (39.0%) or obese (29.9%). The mean Short Form Health Survey version-2.0 (SF-36v2) mental health score for this sample was 65.8 (SD=23.4) out of 100. A substantial majority indicated that their work was full-time (90.9%) and felt that their job was hectic (72.6%). Additionally, more than half (59.4%) of the respondents indicated that they were extremely certain that they would RTW and nearly half (47.8%) reported that their employers were willing to offer job accommodations (Table 3.2).

## BIVARIATE ASSOCIATIONS BETWEEN BASELINE FACTORS AND PHYSICAL THERAPY USE

In our survey sample, we identified 673 (49.1%) workers who received at least one physical therapist service. Findings from our bivariate analyses (Table 3.2) showed that baseline factors from five of the six domains were associated with physical therapy use (all but the health behaviors domain). In the socio-demographic domain, gender, race/ethnicity, annual household income, and location of worker residence were associated with physical therapy use. All variables from the pain and function and psychosocial domains were also significantly associated with physical therapy use. In the clinical domain, body mass index, first provider seen after injury, previous injury resulting in greater than one month off work, and the number of prior workers' compensation claims were associated with physical therapy use. Baseline factors in the employment-related domain were also associated with physical therapy use. Specifically, work demands such as heavy lifting, working fast, excessive amount of work, enough time to get the job done, hectic job, can take breaks, supervisor listens, and an employer who offered work accommodations were associated with physical therapy use. Age, marital status, education, current health status, tobacco use, high risk alcohol use (AUDIT-C), physical demands, part-time work, temporary job, and industry sector were not significantly associated with physical therapy use in the bivariate analyses.

## MULTIVARIABLE ASSOCIATIONS BETWEEN BASELINE FACTORS AND PHYSICAL THERAPY USE

Results of the multivariable logistic regression models adjusted for baseline socio-demographics are shown in Tables 3.3 to 3.5. In Table 3.3, we present the odds ratios (both unadjusted and then adjusted for all other socio-demographic variables) between socio-demographic baseline factors and physical therapy use. In the adjusted model, we observed lower odds of physical therapy use among men compared to women, and among individuals with an annual household income of <$30,000. We also found that age, race/ethnicity, marital status, education, and location of worker residence were not significantly associated with physical therapy use.

Results of the unadjusted and adjusted multivariable logistic regression models between selected baseline factors in four of the six domains (pain and function, psychosocial, clinical, and health behaviors) and physical therapy use are presented in Table 3.4. Consistent with the results from unadjusted models, fourteen baseline factors (pain intensity, pain interference with daily activity, pain interference with work, SF-36v2 physical function, SF-36v2 role physical, RMDQ disability score injury severity, catastrophizing, recovery expectations, fear avoidance composite score, SF-36v2 mental health score, body mass index, first provider seen for injury, and previous injury) were significantly associated ($p \leq 0.05$) with physical therapy use after adjusting for socio-demographic factors. In the pain and function domain, we observed higher odds in physical therapy use among workers who had a higher baseline pain intensity score, pain interference with daily activity and pain interference with work scores, with higher scores indicating more pain. When we examined self-reported measures for physical function and physical role limitations, we found that lower odds of physical therapy use were present among workers with lower SF-36v2 physical function and SF-36 role physical scores (with lower scores indicating poorer function). Higher odds of physical therapy use were found in workers with a higher RMDQ disability score, which indicates greater disability. Compared to workers with mild back sprain/strain, workers with a more severe injury rating (i.e., major sprain/strain, evidence of radiculopathy, severe immobility including loss of reflexes, bladder complaints, and motor abnormalities) had higher odds of physical therapy use.

In the psychosocial domain, we found higher odds of physical therapy use among workers who had higher catastrophizing scores and lower recovery expectations. When we examined the fear avoidance composite score, we found higher odds of physical therapy use in workers who agreed that physical activity and work may have contributed to back pain compared to those who disagreed. Furthermore, we found lower odds of physical therapy use among workers with a higher SF-36v2 mental health score, which indicates better psychological status.

In the clinical domain, individuals who were classified as obese (body mass index ≥ 30) had higher odds of physical therapy use compared to individuals that were classified as normal (body mass index between 18.5-24.9). Compared to workers who saw a primary care provider as their first health care provider after injury, workers who saw a surgeon, physical medicine and rehabilitation provider, and occupational medicine provider had higher odds of physical therapy use; however, workers who saw a chiropractor or emergency medicine provider as their first health care provider after injury had lower odds of physical therapy use. Lastly, we found higher odds of physical therapy use among workers who had a previous injury lasting greater than one month compared to workers who did not. Only four of the baseline factors in Table 3.4 (number of workers' compensation claims, current health status, tobacco use, and AUDIT-C) were not associated with physical therapy use in the adjusted models.

In Table 3.5,we present the results for the unadjusted and adjusted multivariable logistic regression models between baseline employment-related factors and physical therapy use after controlling for all socio-demographic factors. Similar to our unadjusted estimates, we observed that most employment-related factors were associated with physical therapy use in the adjusted models. Specifically, we found that heavy lifting, physical demands, working very fast, excessive amount of work, and hectic job were associated with higher odds of physical therapy use, while lower odds of physical therapy use was observed in workers who had enough time to get the job done, can take breaks, had a supervisor that listens, and had an employer that offered accommodations. There were no significant associations between physical therapy use and temporary work, part-time work, and industry sector (NORA groups) in the adjusted model.

## E. DISCUSSION

To our knowledge, there are few population-based studies that examine the associations between baseline factors and physical therapy use among workers with back pain.[98,99] We found that baseline factors from five of the six domains (socio-demographic, pain and function, psychosocial, clinical, and employment-related) were associated with physical therapy use in the adjusted multivariable models. These findings suggest that use of physical therapist services influenced by many socio-demographic, psychosocial, and employment-related factors beyond traditional clinical and health factors.

Consistent with the results of previous studies focused on the US adult populations (not restricted to injured workers), our analyses indicated that women and higher income were positively associated with physical therapy use.[32,53,54,96] In one US adult population-based survey examining health care utilization and medical expenditures, researchers found that the odds of seeking care from physical therapy providers rather than chiropractors were 1.65 times higher for women compared to men and 2.09 times higher for persons with higher income (those making at least 400% of the poverty level) compared to persons in the low-income category (those making less than 200% of the poverty level).[32]

Across all pain and function measures used in the D-RISC study, our results showed that , greater pain, disability, and injury severity at baseline were associated with physical therapy use. Previous studies showed similar associations between clinical factors (e.g., higher pain levels, greater injury severity, and greater functional limitations) and more physical therapy use or physical therapy referrals.[32,53,54,98,99,102] The associations between physical therapy use and pain and function measures that we have identified are thus consistent with findings from prior studies.

All baseline psychosocial factors (catastrophizing, recovery expectations, fear avoidance composite score, and SF-36v2 mental health scores) in our study were associated with physical therapy use in both the bivariate and multivariable models. Our results add to previous studies that have shown how psychosocial factors may influence the course of a back pain episode including the impact it may have on physical therapy treatment.[94,103,104] While the relationship between psychosocial factors and physical therapy use requires further exploration, greater catastrophizing, lower recovery expectations, greater fear avoidance, and worse mental health scores were significantly associated with work disability at one year based on previous studies.[73,86] Therefore, it is important to better understand how underlying psychosocial factors interact with interventions provided by physical therapists as well as individual social and work environments that may impact access and timing to physical therapy.[105] In addition, physical therapists should be aware of the greater psychological barriers their patients may present with and be prepared to address these barriers with appropriate interventions or referrals. One strategy that has been proven to be effective is psychologically informed physical therapy, which integrates cognitive-behavioral techniques into conventional physical therapy through individual and group-based pain coping activities and exercises.[106]

Our results also found that obese individuals had higher odds of physical therapy use compared to normal weight individuals. This suggests that workers with elevated body mass index levels may be more likely to see a physical therapist and that physical therapists may want to incorporate regular health promotion activities into their clinical practice as a result. A national study of adults with LBP in the US showed that physical activity mitigated the risk of LBP among all individuals; however, it was most beneficial for overweight and obese individuals.[107]. The type of first provider seen after injury was associated with physical therapy use. Workers who saw a surgeon, physical medicine and rehabilitation provider, or occupational medicine provider had higher odds of physical therapy use compared to workers who saw a primary care provider, while workers whose first provider visit was to a chiropractor or emergency medicine provider had lower odds. One possible explanation may be that chiropractors are less likely to refer patients to physical therapy compared to other health care providers because their clinical scope of practice may overlap with that of physical therapists. Emergency medicine providers may see more severe cases, and thus be more likely to refer to other specialists (orthopedics, chiropractors, surgeons) or primary care providers first, rather than referring directly to a physical therapy provider; however, additional research is needed to further explain these differences. Lastly, our results also showed that individuals with a previous injury involving more than a month off work had higher odds of physical therapy use.

A unique aspect of this study is the inclusion of multiple employment-related factors. Many of these employment-related factors (heavy lifting, physical demands, working very fast, excessive amount of work, enough time to get the job done, hectic job, can take breaks, supervisor that listens, and employer offered accommodations for injury) were associated with physical therapy use in our adjusted models. These results suggest that a worker's job demands, work environment, and an employer's decision to accommodate a work injury may influence a worker's ability to seek a physical therapist for treatment of back pain. While previous studies have shown that age group, injury severity, functional limitations, and occupational group are associated with physical therapy use,[98,99] very little is known about the relationships between physical therapy use and specific job tasks, administrative work controls and the working environment. In a national study of workers with LBP, researchers found that certain work-related psychosocial risk factors including the work environment, job insecurity, work hours, and other work organization factors were associated with increased risk of experiencing LBP.[1] Further research is needed to understand the relationships among employment-related factors and physical therapy use.

### LIMITATIONS

This study has some limitations. First, this is a secondary analysis of data from a prospective observational study and the results should be interpreted as associations and not causation. Second, we do not examine all factors that may influence referral to or use of physical therapy services (e.g., whether the worker received surgery, prescription opioids, or other treatments). Next, this study may not be generalizable to an injured worker population outside of WA. Lastly, We acknowledge that our data source may be outdated and may not accurately represent the changes and policy reforms implemented in the healthcare field over the last few decades. Nevertheless, the interview survey data obtained in the D-RISC study are innovative and possess distinctive value for a workers' compensation system.

Despite these limitations, this study has some notable strengths. First, this is one of the first population-based studies of workers with back injuries in a WC system to examine baseline factors associated with physical therapy use. Second, we linked physical therapy use information from a WC administrative claims dataset with self-reported data for many factors that are not routinely captured in WC data. Third, several psychosocial and employment-related factors were found to be associated with physical therapy use, which has not been studied previously. Fourth, this study is unique in that the WC data contains employment-related factors that provide additional information about a patient's work environment, job conditions, and employer information that is not readily available in other data sources.

## F. CONCLUSION

In conclusion, we found that baseline factors from five domains (socio-demographic, pain and function, psychosocial, clinical, and employment-related) were associated with physical therapy use, which may be useful in addressing issues related to employment factors, psychosocial barriers, and health disparities in access to care for injured workers with back pain in a workers' compensation system. These findings may be useful in future research, policy, and practice settings to improve access to physical therapist services and to improve clinical practice for the workers who experience back pain.

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CHAPTER 4: RESEARCH AIM 3

**Title:** Intensity of physical therapy services: Association with work and health outcomes in injured workers with back pain in Washington State

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CHAPTER 4

# Intensity of physical therapy services: Association with work and health outcomes in injured workers with back pain in Washington State

## A. ABSTRACT

BACKGROUND: The associations between the intensity of physical therapy (PT) treatments and health outcomes among individuals with back pain have been examined in the general population; however, few studies have explored these associations among injured workers. Our study objective was to examine whether intensity of PT treatments is positively associated with work and health outcomes in injured workers with back pain.

METHODS: We conducted a secondary analysis of prospective data collected from the Washington State Workers' Compensation (WC) Disability Risk Identification Study Cohort (D-RISC). D-RISC combined survey results with WC data from the Washington State Department of Labor and Industries. Workers with a State Fund WC claim for back injuries between June 2002 and April 2004 and who received PT services within the first year of injury were eligible. Intensity of PT treatment was measured as the type and amount of PT services within 28 days from the first PT visit. Outcome measures included work disability and self-reported measures for working for pay, pain intensity, and functional status at 1-year follow-up. We conducted linear and logistic regression models to test associations.

RESULTS: We identified 662 (35.1%) eligible workers. In adjusted models, although intensity of PT treatment was not significantly associated with work disability at 1-year follow-up, it was associated with lower odds of working, decreased pain intensity, and improved functional status.

CONCLUSIONS: Our findings suggest that there may be small benefits from receiving active PT, manual therapy, and frequent PT treatments within 28 days of initiating PT care.

KEYWORDS: back pain, functional status, physical therapy, return to work, workers' compensation

## B. BACKGROUND

Low back pain (LBP) is a major health problem for the working population. The economic burden of total direct and indirect costs attributable to LBP in the United States (US) is estimated to be greater than $200 billion dollars annually, of which two-thirds is due to lost wages and reduced productivity.[11,14,108,109] While most individuals who have acute LBP are expected to recover within four weeks of onset,[5,6] workers with chronic LBP experience a longer duration of disability and are more prone to become permanently disabled.[110]

In order to manage LBP cases, clinical guidelines recommend the use of non-pharmacological and non-invasive services over prescription pain medications as first-line treatment options for patients experiencing LBP.[6,83] One approach is physical therapy (PT) care, which consists of various PT interventions that have been shown to restore, maintain, and improve functional status and quality of life.[6,83] This rehabilitative strategy consists of various types of PT services conducted at varying frequencies over the entire course of patient care. LBP guidelines recommend that PT providers prioritize active interventions such as exercise therapy, activity training, and manual therapy techniques over other passive strategies including electrical stimulation, hot and cold therapies, and massage for treatment of both acute and chronic back pain.[69,111] In the US, national and state-based population studies showed that less than a third of patients with chronic LBP sought a PT provider within the first year of injury and that there was little to no change in PT utilization from 1997 to 2006 for individuals experiencing back pain.[7,12,72] While PT use in the form of active exercise, manual therapy, and other modalities are recommended for treatment of acute and chronic LBP,[111] the use of PT services is often dependent on the patient's current clinical prognosis, which can impact health outcomes like pain intensity, functional capacity, and duration of disability.

Previous studies have examined the associations between health outcomes and the intensity of PT services among individuals with back pain in the general population; however, few studies have explored these associations among an injured worker population. In one prospective cohort study of older adults with back pain, researchers found that greater amounts of active PT interventions were associated with improvement in pain intensity but found no statistical difference when examining the association with disability outcomes.[58] Another study that examined injured workers with knee pain found that a greater amount of passive PT interventions was associated with longer duration of disability compared to non-users; however, the researchers also found no difference in the length of disability between users receiving active PT interventions and non-active PT users.[59] Evidence has also shown that patients with back pain who received a combination of early and active PT interventions were more likely to experience positive improvements in pain and function outcomes.[61,62,64,66] In this study, our primary study objective was to examine whether intensity of PT treatments during the first four weeks (28 days) of PT care is positively associated with work and health outcomes in injured workers with back pain including work disability and self-reported measures for working for pay, pain intensity, and functional status at 1-year follow-up.

## C. METHODS

### DATA SOURCE

We conducted a secondary analysis of prospective data collected from the Washington State Workers' Compensation Disability Risk Identification Study Cohort (D-RISC), which has been described in prior studies.[73,86] We linked self-reported survey results from D-RISC with administrative claims and medical billing data from the Washington State Department of Labor and Industries (L&I) state fund. The L&I state fund covers over two-thirds (70%) of all non-federal Washington workers. The remaining 30% of all non-federal WA workers is covered by self-insured employers, for which data were not available.

### STUDY POPULATION

The study sampling frame included 4,354 potential participants in the D-RISC that had an accepted or provisional (pending decision) L&I workers' compensation (WC) claim for back injury between June 2002 and April 2004. Workers who received wage-replacement benefits for temporary total disability (four or more days off work) due to injury were eligible for this study. Of the potential participants, 2,147 (49.3%) agreed to participate in the initial screening. The remaining respondents were classified as non-participants because they could not be contacted after injury, declined enrollment into the study, or were unable to complete the telephone interview in English or Spanish (Figure 4.1). Furthermore, we excluded 262 participants because they did not receive compensation within the first year of injury, were hospitalized for injury in the first 30 days, had missing data on age, or did not have a back injury after medical review (Figure 4.1). Among the remaining 1,885 enrolled participants, we used medical billing information to identify the 942 participants who received PT services from a PT provider within the first year after injury; those with no PT services were ineligible. Additionally, we excluded participants who did not complete the follow-up interview one year after injury (n=260) and who only received PT services after surgery (n=20); therefore, our final study sample included 662 participants who received PT services and completed the follow-up interview within the first year of injury.

### MEASURES

### INTENSITY OF PHYSICAL THERAPY

The primary exposure variable for this study was the intensity of PT treatment within 28 days of the first PT visit, which was defined in three ways. First, we measured intensity of PT treatment by type of PT treatment (active PT, passive PT, or manual therapy). For each injured worker, we calculated the total number of active, passive, and manual therapy procedures that occurred within 28 days of the first PT visit. Second, we assessed intensity of PT treatment using the total number of PT codes that were billed by a physical therapist within 28 days of the first PT visit for each injured worker. Lastly, we examined intensity of PT treatment as the total number of PT days within 28 days of the first PT visit. A PT day was counted if an injured worker received any PT code by a physical therapist within 28 days of the first PT visit. We determined that a period of 28 days from the first PT visit would be an appropriate time frame for analysis to reduce confounding by indication, where the amount of PT treatments would be greater for injured workers with prolonged symptoms and disability.

### PHYSICAL THERAPY CODES

We defined a PT user as a worker that had at least one billed PT-related Current Procedural Terminology (CPT) code from a physical therapist within the first year after injury. We selected PT codes using the CPT codes for active PT, passive PT, and manual therapy interventions (Appendix D). Active PT codes generally consisted of exercise therapy and activity training codes, while passive PT codes included modalities such as biofeedback, electrical stimulation, hot and cold therapies, and massage therapy. We created a third category for manual therapy interventions, typically comprised of skilled spinal manipulation, spinal mobilization, and manual traction procedures, which is considered different than non-specific therapeutic massage in research and practice.

### OUTCOME VARIABLES

We examined four outcome variables (work disability,  working for pay, pain intensity, and functional status) at 1-year follow-up. Work disability was defined as a binary variable (yes or no) for workers receiving wage replacement benefits 1-year after their claim submission. Working for pay was defined as a self-reported binary variable (yes or no) for individuals who received employment-related monetary compensation in the previous week prior to the interview survey. Continuous measures for self-reported scores of pain intensity in the past week and functional status were assessed using a 0-10 pain numerical rating scale[112] and the Roland Morris Disability Questionnaire (RMDQ) score, a 0-24 scale,[113] respectively, with higher values indicating greater pain intensity and worse functional status. We reported frequencies and percentages for binary outcomes and means and standard deviations for continuous outcomes.

### COVARIATES

To account for potential confounding between the intensity of PT treatment and each of the outcome measures, baseline covariates were selected *a priori* from five domains (demographic, pain and function, psychosocial, clinical, and employment-related)[73] and included in each of the statistical models (Table 4.1). We constructed a variable to address potential time-varying differences from the onset of injury to when the injured worker first received PT care; time to PT care was defined as the total number of days between the worker's injury date and the first PT visit date. All baseline variables are described in further detail in Table 4.1.

### DATA ANALYSIS

We used descriptive statistics to characterize the study sample. We conducted a total of twelve regression models for this study. Six logistic regression models (unadjusted and adjusted) were conducted to test the associations between each of the three measures for intensity of PT treatments within 28 days of first PT visit and the two binary outcomes for work disability and working for pay at 1-year follow-up. Additionally, we conducted six linear regression models (unadjusted and adjusted) to examine the associations between intensity of PT treatments within 28 days of first PT visit and the continuous outcome measures for self-reported pain intensity in the past week and functional status at 1-year follow-up. For the statistical models that examined intensity of PT treatment by PT type, we adjusted for the other two PT types as well as a variable for the total number of PT evaluation codes for each worker to account for co-occurring PT treatments that the worker received within the first 28 days after their first PT visit. Unadjusted and adjusted odds ratios with 95% confidence intervals were calculated for the logistic regression models and unadjusted and adjusted β coefficients were reported for the multiple linear models. Additionally, we conducted a sensitivity analysis to assess the impact of a possible interaction between timing and intensity of PT treatments. We classified timing as a binary variable for early (4 weeks or less) or late PT (greater than 4 weeks) PT from date of injury. We found that our interaction term comparing timing of PT and intensity of PT was not statistically significant in all models; therefore, we did not include it in the final adjusted analyses. All variables included in the adjusted models had a missing rate of 3.6% or less, which is considered inconsequential.[90,91] Based on a small amount of missing data, our sample size after casewise deletion for each of the twelve regression models consisted of 86.5% of the total study sample (n=574). All statistical analyses were performed using StataCorp SE, version 14 (College Station, TX)[89] with a two-tailed significance level set at alpha=0.05.

## D. RESULTS

We identified 662 (35.1%) workers who received PT services within the first year of injury. Baseline characteristics for this study population are displayed in Table 4.2. Among the 662 workers who received any PT care, most were male (62.7%), White non-Hispanic/Latino (74.9%), and married (55.1%). Most workers had a high school education or greater (89.0%), had an annual household income of $45,000 or more (74.1%), and lived in an urban residential area (59.1%). The mean age for these workers was 40.4 years (SD=10.7). Medical record reviews showed that workers had injuries that caused a mild sprain or strain (42.6%), major sprain or strain (23.9%), or evidence of radiculopathy (28.3%). Although a little more than half (52.6%) of workers had very high recovery expectations, more than half (56.3%) agreed that their work might harm or cause pain to be worse, which was measured using the work-fear avoidance composite score.

Table 4.3 presents the distribution of the intensity of PT treatments within 28 days of the first PT visit among back-injured workers receiving PT services. Among the 662 workers, the mean and median number of days between injury date and the first PT visit were 47 and 21 days, respectively. The median total number of days that injured workers received PT services was 7 days. Our results also showed that workers received a greater number of active PT treatments than passive PT treatments or manual therapy.

Among the 662 workers in our sample, we identified 174 (26.3%) workers who were receiving wage-replacement benefits for work disability one year after injury. From the follow-up interview, there were 371 (56.0%) workers who responded that they were not working in the past week. The reported mean (SD) pain intensity score (0-10 scale) and RMDQ score (0-24 scale) for this worker population receiving PT services at 1-year follow-up was 4.8 (2.8) and 11.1 (7.4), respectively.

### Work disability at 1-year follow-up

We conducted three logistic regression models to test the associations between intensity of PT treatment within 28 days of the first PT visit and work disability at 1-year follow-up after adjusting for covariates (Table 4.4). Although we found modest associations in two of the three unadjusted models *(p*<0.05), there was no significant association between intensity of PT treatment and work disability at 1-year follow-up in the adjusted models.

### Working for Pay at 1- year follow-up

We examined the associations between intensity of PT treatment and self-reported working for pay in the past week at 1-year follow-up using three logistic regression models (Table 4.5). In our adjusted models, we found that a greater amount of active PT was associated with lower odds of working at 1-year follow-up ($p<0.05$).

### Pain intensity score at 1-year follow-up

Results from the multiple linear regression models examining the associations between total intensity of PT services and self-reported pain intensity score at 1-year follow-up are presented in Table 4.6. In the adjusted models, we found that for each additional hour (4 units) of active PT and total PT codes, there was a 0.12 and 0.08 reduction in pain intensity scores at 1-year follow-up, respectively. We also found a 0.06 reduction in pain intensity scores at 1-year follow-up for each additional day of PT treatment. We did not find any significant associations between passive PT and manual therapy treatments and pain intensity scores at 1-year follow-up.

### Roland Morris Disability Questionnaire Score at 1-year follow-up

We conducted three multiple linear regression models that examined the associations between intensity of PT treatments and the RMDQ score at 1-year follow-up (Table 4.7). In the adjusted models, we found that for each additional hour (4 units) of active PT and manual therapy, there was a 0.28 and 0.44 lower RMDQ (better function) score at 1-year follow-up ($p<0.05$), respectively. Our results also indicated that an increase in the number of PT codes and PT days was significantly associated with a 0.16 and 0.16 point decrease in RMDQ scores at 1-year follow-up. We did not find significant associations between passive PT and the RMDQ score at 1-year follow-up.

## E. DISCUSSION

Our results highlight the associations between intensity of PT treatment on work and health outcomes at 1-year follow-up among injured workers with back pain. We found that the intensity of PT treatment among patients receiving PT care—whether measured as the type of PT treatment, total number of PT codes, or total number of PT days—was not associated with work disability at 1-year follow-up. However, there was a small association between higher intensity of active PT treatment and lower odds of self-reported working for pay at 1-year follow-up. We also found that increased intensity of PT treatment was associated with decreased pain intensity and RMDQ scores at 1-year follow-up.

In the adjusted models, our findings showed that a greater amount of active PT was associated with decreased pain intensity and RMDQ scores at 1-year follow-up while receiving passive PT services was not. Additionally, higher use of manual therapy services had a borderline significant association with decreased RMDQ scores at 1-year follow-up ($p$=0.05). These results are consistent with findings from other studies that found associations between the type of PT treatment and greater improvement in pain and function outcomes[58,62,114] and are supported by clinical guidelines, which recommend that non-pharmacological treatments such as active PT and manual therapy procedures be considered as first-line treatment for acute or chronic back pain.[69,111] Systematic reviews also showed how exercise therapy, a common active PT treatment, appears to have a modest effect at decreasing pain and improving function in adults with chronic low-back pain.[27,115]

In a retrospective study of working-age individuals (18-60 year old) with LBP, researchers found that individuals receiving guideline-adherent active PT care were more likely to have fewer clinical visits, lower costs, and improvement in disability scores.[62] In another study from the Netherlands, researchers examined whether adherence to Dutch PT and manual therapy guidelines would improve outcomes among patients with chronic LBP.[114] Results from the Dutch study showed that guideline adherence with an active PT approach was associated with improvement in the patient's physical functioning.[114] Reduction in pain intensity scores were found to be associated with greater amounts of active PT treatments in a prospective cohort study of older adults with back pain compared to older adults that did not receive any active PT.[58] They also found that increased use of passive and manual therapy did not result in significant associations with pain and function outcomes among back injured adults.[58]

While our multiple linear regression models showed statistical significance between two of our outcomes (pain intensity, and RMDQ score) and active PT, the magnitude of associations were small. For example, workers at the 75$^{th}$ percentile of active PT codes had 0.42 lower pain intensity and 0.98 lower RMDQ scores compared to those with no active PT codes. Despite the improvement in pain intensity and RMDQ scores, we do not consider these differences to be clinically meaningful.[116,117]

Our results showed that greater use of active PT was associated with lower odds of working for pay in the past week at 1-year follow-up in the adjusted model. A possible explanation for this may be residual confounding from workers that continue to be symptomatic and in need of medical services, having a longer duration of medical care and inability to RTW at full capacity. Having increased numbers of PT codes (active, passive, or manual therapy) may indicate that a worker still requires medical treatment and consequently remains unable to work at full capacity. There are other factors that are associated with negative RTW outcomes. In a systematic review of factors affecting negative RTW outcomes, the researchers found that older age, being female, greater pain or disability, depression, higher physical job demands, previous sick leave and unemployment, or activity-related limitations were factors that may explain not working.[118] Additionally, it is possible that work outcomes are affected by other individual factors beyond clinical measures such as pain and function, including psychological, health behaviors, and the work environment that need to be accounted for prior to returning to work.

Our results also showed that workers who received a greater number of PT codes and PT days experienced a small association with improvement in RMDQ scores at 1-year follow-up in the adjusted model, which suggests that workers with back pain receiving greater intensity of PT treatments may have small but positive functional outcomes. When we examined the 75$^{th}$ percentile of total PT codes (~7 hours of PT treatment) and total PT days for these workers, we saw a reduction in the RMDQ score of 1.40 and 1.44, respectively. Again, while our study found small differences in the RMDQ score, it may not be clinically meaningful.[119]

One potential explanation for these small differences in 1-year outcomes is that most workers who initiated PT care within the first two months (75$^{th}$ percentile = 54 days), may see the impact on outcomes wane over time as the time since treatment increases. Another consideration is the need of a comprehensive and interdisciplinary approach including the use of other clinical treatments, psychosocial interventions, and health-related strategies for the back injury. For example, a recent meta-analysis of systematic reviews concluded that combining behavioral therapies, such as cognitive behavioral therapy, with active exercise therapies was better than either type of therapy alone.[120] It is possible that injured workers receiving PT care through a WC system tend to suffer from temporary or permanent disability and continue to have a worse prognosis for RTW outcomes, leading to potentially greater use of PT services. Thus, more research is needed to better understand whether a combination of PT services with other non-pharmacological and pharmacological treatments improves a worker's overall health outcome and ability to RTW.

## LIMITATIONS

This study is subject to some limitations. First confounding by indication is recognized as a limitation. Although we incorporated baseline measures for pain intensity and RMDQ scores in our adjusted models, some workers received PT services prior to the baseline interview, which was administered roughly 3 weeks after a WC claim was submitted to L&I and the results of these PT treatments may have influenced the worker's initial response to the baseline interview (e.g., indicating improvement in baseline pain intensity and RMDQ scores at baseline). Secondly, we did not account for additional factors such as whether the worker received prescription drugs and other pain medications in our adjusted models as well as information about the timing and coordination of the PT referral, which can lead to delayed treatment with a PT provider. Other factors such treatments provided by other non-PT providers and the lack of information about active fitness levels outside the scope of medical treatments were not captured in this study. Third, our study was subject to recall and social desirability biases for three of the outcome measures from the follow-up interview survey (working for pay, pain intensity, and RMDQ scores). Fourth, the impact of PT benefits may also be degraded over time as the follow-up interview was approximately 1-year after the baseline interview. Fifth, while PT codes were used to identify intensity of PT treatment in this study, we are still uncertain about whether PT interventions were accurately and consistently received by the worker and implemented as planned. For example, we do not know whether PT care such as active exercise or activity training was performed at home or routinely followed based on the PT provider's recommendation. Sixth, this study was conducted among an injured working population in WA and the intensity of PT treatments that each injured worker received may differ based on each

WC system's coverage plan for PT services. In WA, injured workers are allowed up to 12 PT visits with no authorization and between 12 to 24 PT visits with the recommendation of their health care provider; however, any additional visit exceeding 24 visits will require a formal utilization review. Differences in PT utilization as well as the specific PT procedural codes that are covered in the WA WC system may impact the injured worker's care coordination and recovery time; therefore, our methods and results may not be generalizable to other injured workers in other states. Lastly, we recognize that our data source is dated and may not reflect the changes and policy reforms that have been enacted over the last few decades in the health care field; however, the interview survey data that are captured in the D-RISC study are novel and have unique value for a WC system.

Despite these limitations, this study has some notable strengths. First, this is a population-based study of workers with back injuries. Second, we were able to link WC claims data with data that are not routinely captured in WC systems, including self-reported demographic, pain and function, psychosocial and health behavioral, health status, and employment-related data. Third, this study addresses a fundamental gap in the literature regarding post-injury treatment and specifically PT care for injured workers with back pain, which has not been widely studied in this population.

## F. CONCLUSION

To our knowledge, this is one of the first studies to examine the implications of intensity of PT care on work and health outcomes among an injured working population with back pain. While we did not find any strong associations between the intensity of PT treatment on work and health outcomes at 1-year follow-up, our results suggest that workers who received active and frequent PT treatments within the first 28 days of initiating PT care had a small, but positive association with less pain and improved functional status at 1-year follow-up. The results of this study could help stakeholders, such as physicians, PT providers, injured workers, WC systems, and policy makers, better understand whether active PT services are beneficial to work and health outcomes and how to improve clinical practice patterns to better benefit patients. Additional research is needed to better understand whether a more comprehensive and interdisciplinary approach for treatment of back pain would be beneficial for workers, including strategies that address psychosocial, work-related, and health behavioral factors. Furthermore, it may also be important to better understand the relationships between the use of active PT on work and health outcomes for workers with back pain.

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# CHAPTER 5: CONCLUSION

## A. SUMMARY OF DISSERTATION RESEARCH FINDINGS

Through this proposed research, I examined access, utilization, and outcomes of PT services for injured workers with back pain in WA. Results of this study expand current knowledge about the availability of PT providers and accessibility to PT services across WA, identify worker characteristics and other factors that are associated with PT use and non-use, and assess the impact of the intensity of PT services on work and health outcomes for workers with back pain.

In Chapter 2, our findings showed that workers residing in small rural and isolated small towns experienced a lengthier median travel distance of 14 miles and a longer delay of up to 19 days before their initial visit to a PT provider compared to workers residing in urban areas. The variation in access to PT services by rural and urban areas may be influenced by various factors that have been previously discussed in Chapter 2 including the availability of PT providers, transportation barriers, and administrative challenges.

In Chapter 3, we identified worker characteristics and other factors that are associated with PT use and non-use. Among the 1,370 eligible study participants in the D-RISC study, we identified 673 (49%) workers who received at least 1 PT services. Our findings showed that baseline factors from five of the six domains (all but health behaviors) were associated with PT use including gender, annual household income, pain and function measures, injury severity rating, catastrophizing, recovery expectations, fear avoidance, mental health score, BMI, first provider seen for injury, previous injury, and several work-related factors. Identifying these factors may be useful in addressing issues related to employment and work environment, psychosocial barriers, and health disparities that limit access to PT services for injured workers with back pain in a WC system.

In Chapter 4, we examined a subset of workers receiving PT services from the D-RISC study to characterize the associations between intensity of PT services on work and health outcomes among a workers with back pain in WA. Our results showed that among the 662 eligible workers, intensity of PT treatment, measured as the total amount and type of PT services, was not significantly associated with work disability at 1-year follow up. We also found that intensity of PT treatment was associated with lower odds of working for pay, decreased pain intensity, and improved functional status at 1-year follow-up. Our findings suggest that there may be small benefits from receiving active PT, manual therapy, and frequent PT treatments within 28 days of initiating PT care.

## B. POLICY IMPLICATIONS

This research presents insights into the accessibility, utilization, and outcomes of PT services for workers with back pain in WA, yielding significant implications for policy considerations. This dissertation delves into various aspects of PT service delivery, identifying factors associated with

PT use and non-use, and understanding the impact of treatment intensity on work and health outcomes.

The findings in Chapter 2 highlight the disparities in access to PT services, mostly between rural and urban areas. Workers residing in small rural and isolated towns face major challenges, with lengthier travel distances and delays to their initial PT visits. These disparities stem from factors like limited provider availability, transportation barriers, and administrative obstacles. Addressing these differences demands targeted policies to improve access to PT services in underserved areas, potentially through incentives for PT providers to establish practices in rural areas or enhanced transportation options for workers seeking care. Other possible policy improvements may be increased use of telemedicine practices for PT providers and a traveling position for PT providers to visit the worker at home (e.g., home health care).

Chapter 3's identification of worker characteristics and other factors associated with PT use or non-use highlights the multidimensional nature of access barriers. Factors from various domains such as socio-demographics, psychosocial, and employment-related factors influence PT use. To address this, policies should promote inclusivity by integrating these factors into eligibility criteria and financial systems to ensure equitable access to PT services for all workers, regardless of their backgrounds. This may not be a major hurdle in WC since all the workers in this research were covered; however, addressing the potential hurdles for accessing PT services based on these factors may be warranted (e.g., non-professional office workers that have a typical 8am-5pm schedule may not have the flexibility to see a PT provider during the work week).

In Chapter 4, we examined the intensity of PT services on work and health outcomes. Although intensity of PT treatment wasn't significantly associated with work disability, it did show positive associations with increased chances of returning to work, decreased pain intensity, and improved functional status. These findings call for policies that incentivize early and active PT interventions, promoting comprehensive and frequent treatments in the initial stages of care to maximize positive outcomes for injured workers by following clinical guideline recommendations. Sharing these findings with appropriate stakeholders including clinicians, policymakers, and workers may help improve utilization of PT services and work and health outcomes.

Overall, our research underscores the need for a multifaceted policy approach to enhance access, utilization, and outcomes of PT services for workers with back pain. To enhance access to PT services, it may be essential to develop targeted strategies that bridge the disparities that exist between rural and urban areas. These targeted strategies may include focusing on worker-specific factors that may impede a worker’s access to PT services, improvement of care coordination efforts to reduce potential delays to a PT provider, and advocacy of early and active PT inventions as part of clinical treatment plans through educational and media resources and early referral programs. By enacting these policies, employers and government officials can foster a more inclusive, effective, and equitable approach for accessing PT services in WA, which may lead to an overall improvement in well-being and productivity WA workers.

## C. STUDY LIMITATIONS

This study has several limitations. Although this proposed study uses a large, statewide population-based sample, subjects are restricted to injured workers with back pain within the WA WC system. As such, these results may not be generalizable beyond an insured working population with back pain. In order to qualify for wage replacement benefits in WA, the injured worker must have 4 or more days of missed work due to injury. The number of lost work days to qualify for wage replacement benefits differs across states, so results of this study may not be generalizable outside of WA.

As with all observational studies, control for observed and unobserved confounders poses a significant challenge. Confounding occurs when the presence of a third factor, which has not been accounted for, leads to an association between the treatment and outcome that does not reflect a casual effect. The estimates obtained from this study may be biased if there is inadequate adjustment for confounding. In Chapter 3 and Chapter 4, we selected self-reported variables (e.g., injury severity, pain intensity, functional status, and psychosocial measures) from the D-RISC study, which are not routinely captured in administrative claims datasets as covariates in our adjusted models. Incorporating these covariates and creating other variables (e.g., timing to first PT visit) have helped with confounding that may otherwise not be readily available in the dataset.

Limitations for self-reported data using the data from the D-RISC study include recall and social desirability biases, which are common types of information bias. Due to the prospective nature of the original D-RISC study design, respondents to the self-reported survey may not have accurately recalled events that happened in the last month or even in the last year.[123] In addition to recall bias, reporting of risk factors, exposures, or outcomes that are felt to be socially undesirable or related to a social stigma (e.g., annual household income, smoking habits, alcohol usage, or political affiliation) tend to distort the bias towards a socially favorable direction.[123] Moreover, other respondent characteristics such as social acceptance, length of the time between the D-RISC interview and date of first PT visit, interest in the interviewer's question, and degree of detail in responses are known to impact accurate recall.[123]

Another potential limitation to this study is missing data in key variables, which may lead to biased or incorrect results. In Chapter 4, we found that all variables included in the adjusted models had a missing rate of 3.6% or less, which was deemed inconsequential (less than 5% missing). In Chapter 2, we did not have any missing information on key variables (e.g., worker's residential address or provider business location) that was needed to create rural and urban categories and measures for travel distance. In Chapter 3, we did not have any missing information on selected variables found in Table 3.2 for all 1,370 workers in that study aim.

## D. OPPORTUNITIES FOR FUTURE RESEARCH

Based on the findings and culmination of this dissertation, the following list are four potential opportunities for future research.

### Explore additional geographical disparities in access to PT services

This dissertation revealed significant disparities in access to PT services between rural and urban areas. Workers in rural areas experienced lengthier travel distances and greater delays in receiving PT care compared to their urban counterparts. One of the primary challenges contributing to this disparity is the scarcity of PT clinics and providers in rural regions. This disparity may be attributed to the limited healthcare infrastructure prevalent in rural areas, resulting in fewer available clinics and providers. It may be beneficial to examine other modes of PT care and its feasibility to improve the health of the work (e.g., use of telemedicine services, traveling PT provider, collaboration with existing local medical providers and medical facilities in rural areas)

### Impact on Timely Treatment and Health Outcomes in rural areas

The delay in receiving PT care is of particular concern, as workers in rural areas experienced a substantial 16 to 20-day delay in their first PT visit after injury, compared to urban workers. This delay could potentially lead to suboptimal health outcomes for workers in rural areas, as they might resort to alternative methods of pain management or treatment, such as opioids or prescription drugs. This situation could be exacerbated if the symptoms persist into the chronic phase of injury (12+ weeks). Additionally, this dissertation highlighted the potential impact of transportation barriers on accessing PT services in rural areas, where limited public transportation options and long distances to PT clinics can create significant hurdles for individuals with limited mobility, financial constraints, or lack of personal transportation. It may be beneficial to further investigate how clinical care coordination efforts can improve outcomes for workers residing in rural areas. Perhaps, investigating the impact of the L&I Centers of Occupational Health and Education (COHE) on PT use in treating LBP conditions among workers residing in rural versus urban areas.

### Investigate the relationships between socioeconomic factors and access to PT care

While both rural and urban areas face challenges related to affordability, insurance coverage, and cultural barriers, rural residents often face greater financial challenges due to lower incomes and higher out-of-pocket expenses. Urban areas, while offering better availability of PT services, may still pose affordability concerns due to higher living costs and insurance premiums. This interaction of socioeconomic factors can further compound the disparities in accessing PT care for both rural and urban workers, particularly those from lower socioeconomic backgrounds or minority groups. It may be beneficial to investigate these possible differences.

### Explore combinations of intensity and timing of PT services with other medical treatments and prescription drugs on work and health outcomes

Our findings from Chapter 4 offered insights into the effectiveness of PT interventions by examining the relationship between PT intensity on multiple work and health outcomes. Although we identified small associations between greater PT treatment intensity and improvements in pain intensity and functional outcomes, these differences were not determined to be clinically significant. This highlights the need for further research to explore possible combination of medical treatments, psychological interventions (e.g., use of cognitive behavioral therapy), and the influence of work environments and work culture on work and health outcomes.

## E. CONCLUSION

In this dissertation, we discovered that workers residing in rural areas faced lengthier travel distances and delays in accessing PT services compared to workers residing in urban areas. We found that access to timely PT care may be influenced by factors such as clinic and provider availability, transportation barriers, language barriers, and administrative hurdles including care coordination, which affect both rural and urban communities. Addressing these challenges is essential in bridging the gap in accessing PT services. Additionally, our research identified key factors across socio-demographic, clinical, pain and function, psychosocial, and employment domains that were associated with PT use for workers with back pain. While the intensity of PT care within the initial 28 days was not strongly correlated with work and health outcomes at 1-year follow-up, those receiving active and frequent PT treatments exhibited slight improvements in pain intensity and functional status scores. Our findings underscore the need for a comprehensive interdisciplinary approach to treat back pain for workers and better understand the impact of active PT on work and health outcomes. Further research is recommended to guide clinical practices and health policies to improve the worker's overall health outcomes and RTW prospects.

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Figure 1.1. Conceptual Model – Access to Physical Therapy Services

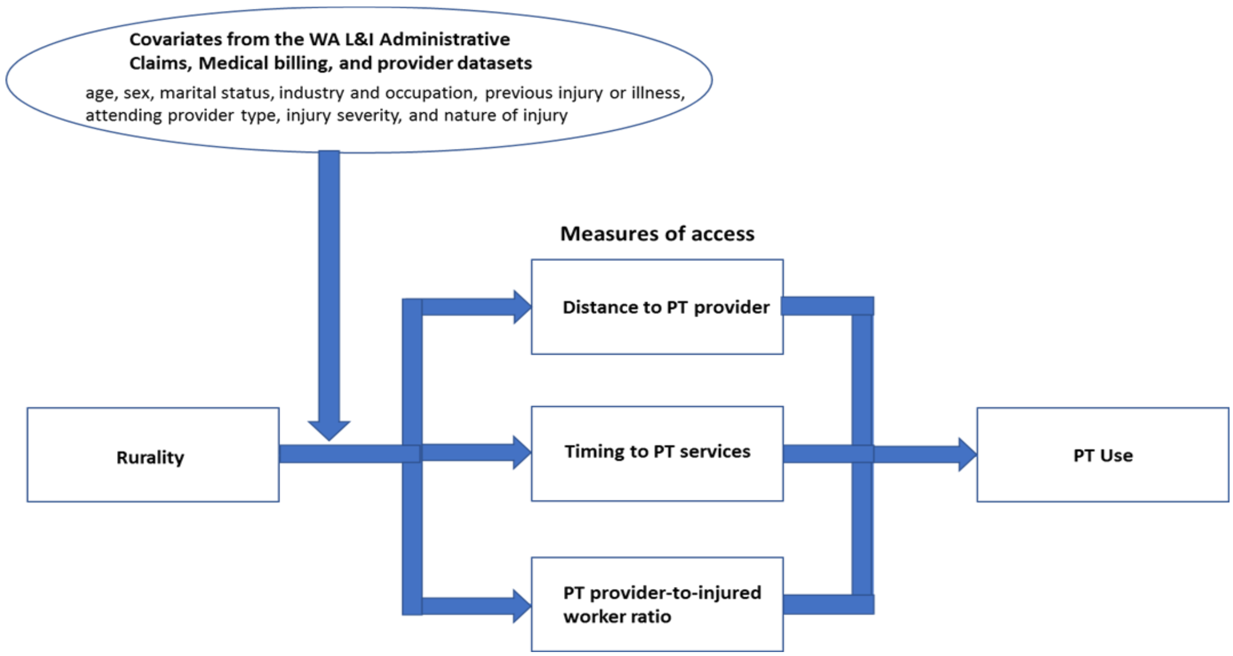


Figure 1.1 describes the relationship between rurality and the measures of access (distance to a PT provider, timing to PT services, and PT provider-to-injured worker ratio) to PT services. Consistent with the Andersen-Newman Behavioral Model of Health Services Use, the proposed Access to PT Services model highlights predisposing factors (i.e., age, sex, marital status, industry, occupation, and previous injury or illness), enabling factors (i.e., attending provide type), and need factors (i.e., injury severity and nature of injury) between rurality and each measure of access.

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Figure 1.1. Predictors of Physical Therapy Utilization and Outcomes

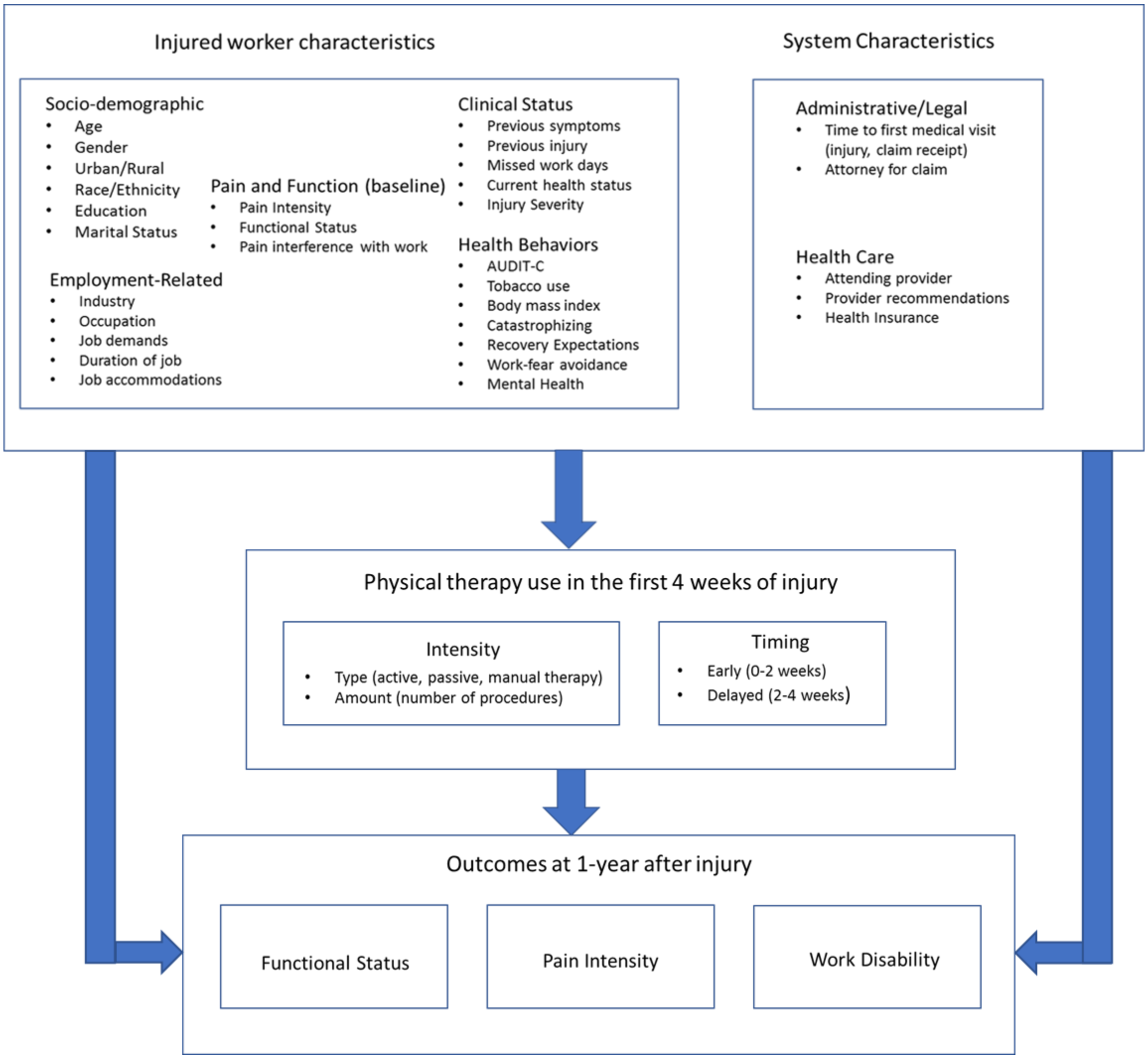


Figure 1.2 describes the conceptual framework for Chapter 3 and Chapter 4 for injured workers with back pain. In the upper half of Figure 1.2, associations between various predictors and PT use will be examined (Specific Aim 2). The seven domains (i.e., socio-demographic, employment-related, clinical status, pain and function, health behaviors, administrative and legal, and health care) from the Disability Risk Identification Cohort Study (D-RISC) represent the possible predictors of PT use, which are classified as either injured worker or system characteristics.[73] Based on previous literature, I expect predictors including female sex, older age, higher socioeconomic status (SES), residence in an urban area, poor self-rated health, higher pain intensity, poorer functional status, and living with a severe or chronic condition to be associated with PT use.[32,53,54] Additional factors (e.g., health behaviors and employment-related) are included in the conceptual model for chapter 3 as possible predictors for PT use. In the lower half of Figure 1.2, I depict the associations between the intensity (Aim 3a) and timing (Aim 3b) of

PT use in the first 4 weeks of injury and outcomes (functional status, pain intensity, and work disability) at 1 year after injury. Adjustment for possible confounders will include factors from the seven domains in D-RISC that are known to be associated with both PT use and each outcome measure based on previous literature and findings from chapter 3.

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Figure 3.1. Disability Risk Identification Cohort Study (D-RISC) Recruitment Flow Chart

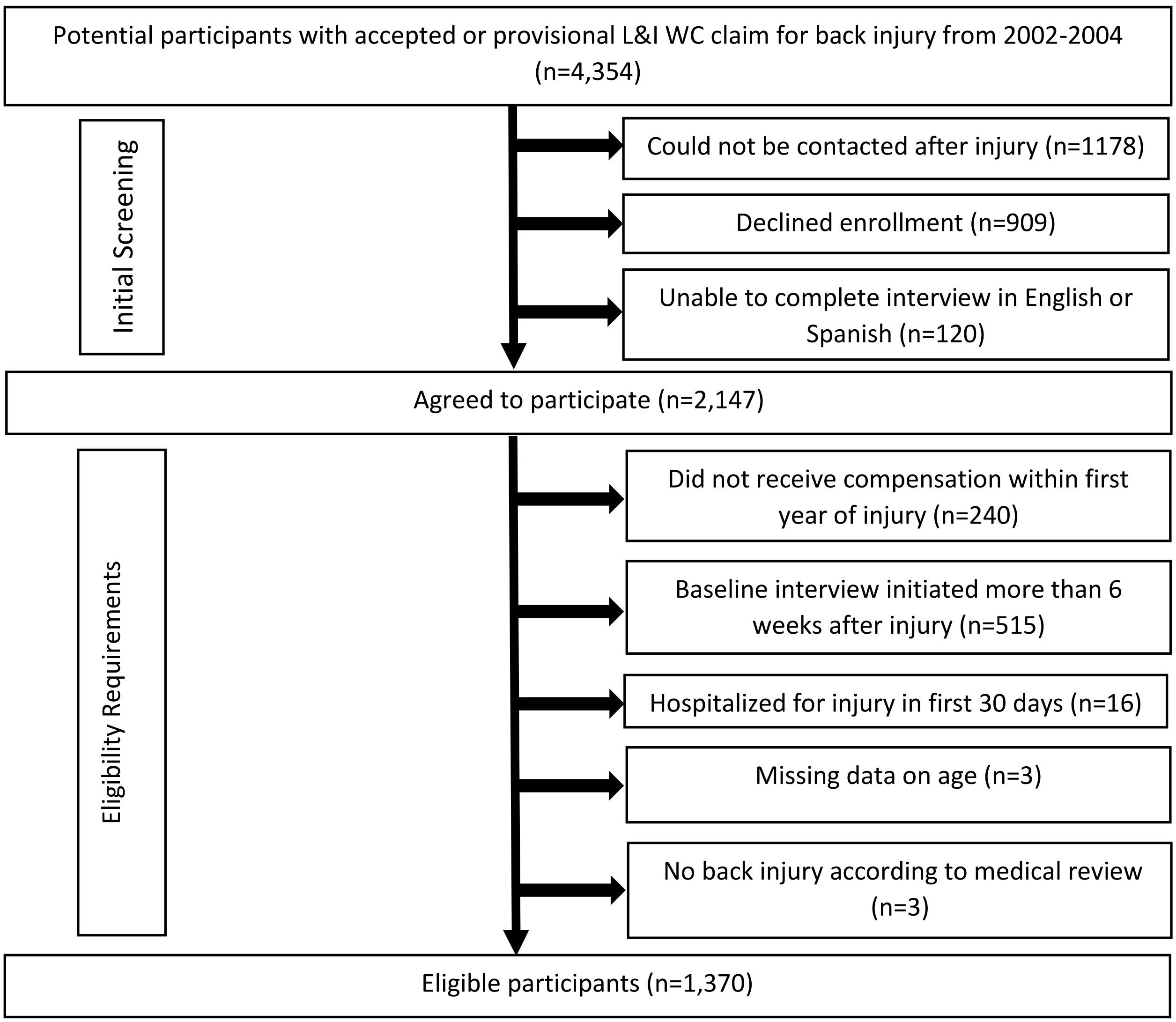

Figure 4.1. Disability Risk Identification Cohort Study (D-RISC) Recruitment Flow Chart

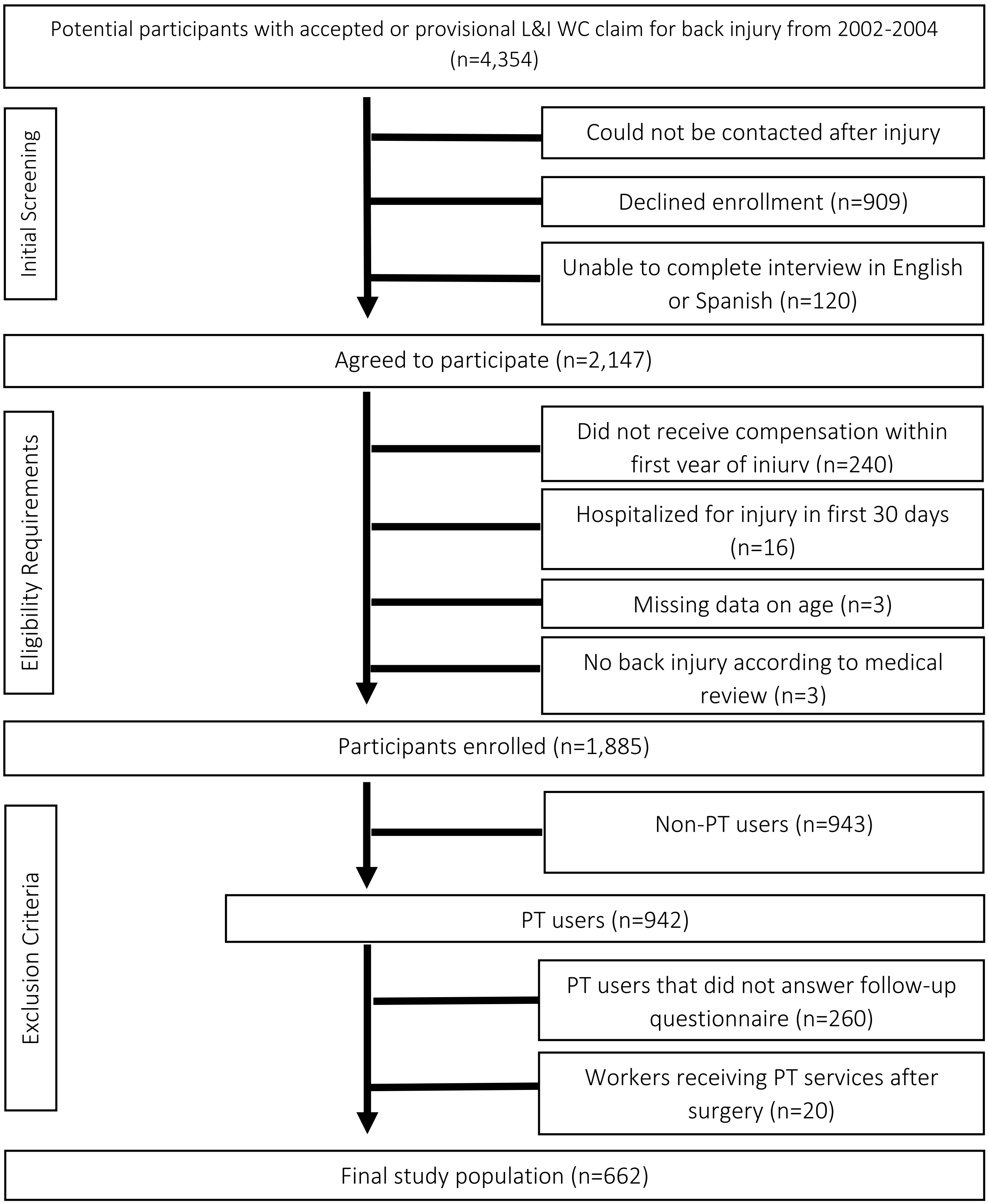

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Table 1.1. Overview of Methods

| | Aim 1 | Aim 2 | Aim 3 | |
|---|---|---|---|---|
| Objective | Examine variation in access to PT services among workers with back pain in WA between rural and urban areas. | Identify predictors of PT use versus non-use among workers with back pain. | Test whether work disability and self-reported pain and function scores assessed at 1 year differ for workers by intensity of active, passive, and manual therapy in the first 4 weeks of injury. | Test whether work disability and self-reported pain and function scores assessed at 1 year differ for workers receiving early versus delayed PT services in the first 4 weeks of injury. |
| Data Sources | WA WC administrative claims, medical billing, and provider data | D-RISC from 2002-2004 | | |
| Study Sample | Injured workers with back pain* diagnoses from 2016-2019 | Workers with back injuries** that were able to complete a telephone interview in English or Spanish, not hospitalized for injury in the first 30 days, and had 4 or more missed days due to work | | |
| Primary Outcomes | Distance to PT provider (miles), Timing to first PT visit (days), PT provider-to-injured worker ratios | PT use (yes or no), total number of PT visits | Work disability measured as time loss (yes or no), self-reported work status (yes or no), pain intensity (0-10 scale), functional status (0-24 scale) at 1 year follow-up | |
| Independent Variables | Rurality (rural vs urban location) | See Table 3.1 | Intensity of PT treatment (amount and type of active, passive, manual therapy) in the first 4 weeks of injury | Timing to PT services (early group: 0-2 weeks, delayed group: 2-4 weeks) |
| Main Analyses | Descriptive statistics, linear regression, Cox proportional hazard model, GIS mapping for PT provider-to-injured worker ratios | Bivariate analysis, multivariate logistic regression model, two-part model adjusted for covariates | PS estimation and PS matching for intensity of PT treatment and timing to PT services,linear and logistic regression models adjusted for covariates | |

| | | | |
|---|---|---|---|
| **Covariates** | Age, sex, marital status, industry and occupation classifications, attending provider, body part, and nature of injury | Age, sex, pain intensity, functional status, pychosocial, and employment characteristics | Age, sex, education, urban or rural residence, health status, injury severity, pain intensity, functional status, recovery expectations, work-fear avoidance, catastrophizing and findings from Aim 2 |

*Definition of back pain is based on OIICS body part and nature of injury codes and exclusions are based on ICD-9-CM and ICD-10-CM (See Appendices C & D)
**Back injuries were identified by trained interviewers using claims from the L&I WC SF between July 2002 and April 2004

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Table 2.1. Chapter 2 Covariates

| Covariates | Data Source | Categories or scores for each measure |
|---|---|---|
| Age Group | Claims | 18-24; 25-34; 35-44; 45-54; 55-64, and 65+; (categorical; reference = 18-24) |
| Gender | Claims | Men (0), Women (1); (binary; reference = men) |
| Marital status | Claims | Married (0), single (1); (binary; reference = married) |
| Attending provider | Claims | Physician, physician assistant, nurse practitioner, chiropractor, other; (categorical; reference = physician) |
| Traumatic injury | Medical Billing | No (0), yes (1); (binary; reference = no) |
| Multiple injury | Medical Billing | No (0), yes (1); (binary; reference = no) |
| Industry | Claims | Agriculture, forestry, fishing, and mining; construction; health care and social assistance; manufacturing; services; transportation, warehousing, and utilities; wholesale and retail trade; (categorical; reference = construction) |
| Occupation | Claims | Management, business, science, and arts; services; sales and office; natural resources, construction, and maintenance; production, transportation, and material moving; (categorical; reference = services) |

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Table 2.2. Demographic, Health-Related, and Occupational Characteristics of Back Injured Workers by Rural and Urban Categories, 2016-2019 (N=47,785)

| Claim characteristics for back injured workers | Total, n (%) | Urban area, n (%) | Large rural city or town, n(%) | Small rural town, n (%) | Isolated small town, n (%) | *p-value* |
|---|---|---|---|---|---|---|
| Age Group (years, n=47,785) | | | | | | .0010 |
| 18-24 | 6,449 (13.5) | 5,571 (13.6) | 566 (14.0) | 204 (12.1) | 108 (11.5) | |
| 25-34 | 13,272 (27.8) | 11,514 (28.0) | 1,053 (26.0) | 441 (26.2) | 264 (28.1) | |
| 35-44 | 11,353 (23.8) | 9,810 (23.9) | 947 (23.3) | 377 (22.4) | 219 (23.3) | |
| 45-54 | 9,431 (19.7) | 8,072 (19.6) | 803 (19.8) | 372 (22.1) | 184 (19.6) | |
| 55-64 | 6,262 (13.1) | 5,277 (12.8) | 597 (14.7) | 243 (14.5) | 145 (15.4) | |
| 65+ | 1,018 (2.1) | 860 (2.1) | 92 (2.3) | 45 (2.7) | 21 (2.2) | |
| Sex (n=47,784) | | | | | | <.0001 |
| Male | 31,560 (66.1) | 27,033 (65.8) | 2,638 (65.0) | 1,190 (70.8) | 699 (74.3) | |
| Female | 16,224 (34.0) | 14,071 (34.2) | 1,420 (35.0) | 491 (29.2) | 242 (25.7) | |
| Marital Status (n=47,240) | | | | | | <.0001 |
| Married | 21,219 (44.9) | 17,782 (43.8) | 2,076 (51.4) | 878 (52.5) | 483 (51.8) | |
| Single | 26,021 (55.1) | 22,810 (56.2) | 1,965 (48.6) | 796 (47.6) | 450 (48.2) | |
| Attending Provider (n=47,723) | | | | | | <.0001 |
| Physician | 19,125 (40.1) | 17,002 (41.4) | 1,299 (32.1) | 465 (27.7) | 359 (38.2) | |
| Physician assistant | 11,539 (24.2) | 9,670 (23.6) | 1,054 (26.0) | 598 (35.6) | 217 (23.1) | |
| Nurse practitioner | 6,192 (13.0) | 5,183 (12.6) | 608 (15.0) | 233 (13.9) | 168 (17.9) | |
| Chiropractor | 8,984 (18.8) | 7,636 (18.6) | 903 (22.3) | 306 (18.2) | 139 (14.8) | |
| Other | 1,883 (4.0.0) | 1,559 (3.8) | 186 (4.6) | 80 (4.8) | 58 (6.2) | |
| Traumatic Injury (n=47,422) | | | | | | <.0001 |
| Yes | 39,693 (83.7) | 34,437 (84.4) | 3,210 (79.6) | 1,317 (78.9) | 729 (78.1) | |
| No | 7,729 (16.3) | 6,350 (15.6) | 822 (20.4) | 353 (21.1) | 204 (21.9) | |
| Multiple Injury (n=47,785) | | | | | | .0370 |
| Yes | 14,895 (31.2) | 12,869 (31.3) | 1,272 (31.4) | 473 (28.1) | 281 (29.9) | |
| No | 32,890 (68.8) | 28,235 (68.7) | 2,786 (68.7) | 1,209 (71.9) | 660 (70.1) | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Industry** (n=47,778) | | | | | | <.0001 |
| Agriculture, forestry, fishing, and mining | 3,676 (7.7) | 1,718 (4.2) | 1,006 (24.8) | 641 (38.1) | 311 (33.1) | |
| Construction | 6,638 (13.9) | 6,102 (14.9) | 342 (8.4) | 107 (6.4) | 87 (9.3) | |
| Health care and social assistance | 7,077 (14.8) | 6,126 (14.9) | 654 (16.1) | 189 (11.2) | 108 (11.5) | |
| Manufacturing | 4,014 (8.4) | 3,458 (8.4) | 377 (9.3) | 111 (6.6) | 68 (7.2) | |
| Services | 15,088 (31.6) | 13,512 (32.9) | 983 (24.2) | 382 (22.7) | 212 (22.5) | |
| Transportation, warehousing, and utilities | 2,870 (6.0) | 2,573 (6.3) | 199 (4.9) | 67 (4.0) | 31 (3.3) | |
| Wholesale and retail trade | 8,415 (17.6) | 7,611 (18.5) | 496 (12.2) | 184 (11.0) | 124 (13.2) | |
| **Occupation** (n=46,232) | | | | | | <.0001 |
| Management, business, science, and arts | 4,708 (10.2) | 4,234 (10.7) | 311 (7.9) | 106 (6.5) | 57 (6.2) | |
| Services | 12,063 (26.1) | 10,554 (26.5) | 971 (24.7) | 354 (21.8) | 184 (20.0) | |
| Sales and office | 4,459 (9.6) | 4,064 (10.2) | 260 (6.6) | 77 (4.8) | 58 (6.3) | |
| Natural resources, construction, and maintenance | 12,920 (28.0) | 10,256 (25.8) | 1,457 (37.1) | 772 (47.6) | 435 (47.3) | |
| Production, transportation, and material moving | 12,082 (26.1) | 10,655 (26.8) | 928 (23.6) | 313 (19.3) | 187 (20.2) | |

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Table 2.3. Demographic, Health-Related, and Occupational Characteristics of Back Injured Workers Receiving Physical Therapy Services by Rural and Urban Categories between 2016-2019 (N=17,632)

| Claim characteristics for back injured workers | Total, n (%) | Urban area, n (%) | Large rural city or town, n(%) | Small rural town, n (%) | Isolated small town, n (%) | *p-value* |
|---|---|---|---|---|---|---|
| Age Group (years, n=17,613) | | | | | | <.0001 |
| 18-24 | 1,838 (10.4) | 1,706 (10.6) | 96 (9.4) | 18 (5.9) | 18 (8.7) | |
| 25-34 | 4,676 (26.6) | 4,322 (26.9) | 238 (23.3) | 69 (22.6) | 47 (22.8) | |
| 35-44 | 4,470 (25.4) | 4,073 (25.3) | 261 (25.5) | 82 (26.8) | 54 (26.2) | |
| 45-54 | 3,794 (21.5) | 3,426 (21.3) | 233 (22.7) | 85 (27.8) | 51 (24.8) | |
| 55-64 | 2,451 (13.9) | 2,196 (13.7) | 176 (17.2) | 47 (15.4) | 32 (15.5) | |
| 65+ | 384 (2.2) | 355 (2.2) | 20 (2.0) | 5 (1.6) | 4 (1.9) | |
| Sex (n=17,613) | | | | | | <.0001 |
| Male | 11,251 (63.9) | 10,255 (63.8) | 626 (61.2) | 212 (69.3) | 158 (76.7) | |
| Female | 6,362 (36.1) | 5,823 (36.2) | 397 (38.8) | 94 (30.7) | 48 (23.3) | |
| Marital Status (n=17,351) | | | | | | <.0001 |
| Married | 7,909 (45.6) | 7,072 (44.7) | 562 (55.2) | 174 (57.2) | 101 (49.3) | |
| Single | 9,442 (54.4) | 8,751 (55.3) | 457 (44.9) | 130 (42.8) | 104 (50.7) | |
| Attending Provider (n=17,609) | | | | | | <.0001 |
| Physician | 8,351 (47.4) | 7,805 (48.6) | 375 (36.7) | 91 (29.7) | 80 (38.8) | |
| Physician assistant | 4,545 (25.8) | 4,063 (25.3) | 293 (28.6) | 123 (40.2) | 66 (32.0) | |
| Nurse practitioner | 2,451 (13.9) | 2,159 (13.4) | 196 (19.2) | 51 (16.7) | 45 (21.8) | |
| Chiropractor | 1,865 (10.6) | 1,677 (10.4) | 140 (13.7) | 37 (12.1) | 11 (5.3) | |
| Other | 397 (2.3) | 370 (2.3) | 19 (1.9) | 4 (1.3) | 4 (1.9) | |
| Traumatic Injury (n=17,502) | | | | | | <.0001 |
| Yes | 14,999 (85.7) | 13,770 (86.2) | 818 (80.5) | 248 (81.1) | 163 (79.9) | |
| No | 2,503 (14.3) | 2,206 (13.8) | 198 (19.5) | 58 (19.0) | 41 (20.1) | |
| Multiple Injury (n=17,613) | | | | | | .0390 |

| | | | | | | |
|---|---|---|---|---|---|---|
| Yes | 4,980 (28.3) | 4,591 (28.6) | 267 (26.1) | 76 (24.8) | 46 (22.3) | |
| No | 12,633 (71.7) | 11,487 (71.5) | 756 (73.9) | 230 (75.2) | 160 (77.7) | |
| **Industry** (n=17,611) | | | | | | <.0001 |
| Agriculture, forestry, fishing, and mining | 853 (4.8) | 461 (2.9) | 218 (21.3) | 115 (37.6) | 59 (28.6) | |
| Construction | 2,563 (14.6) | 2,409 (15.0) | 101 (9.9) | 26 (8.5) | 27 (13.1) | |
| Health care and social assistance | 2,775 (15.8) | 2,565 (16.0) | 159 (15.5) | 30 (9.8) | 21 (10.2) | |
| Manufacturing | 1,506 (8.6) | 1,386 (8.6) | 88 (8.6) | 17 (5.6) | 15 (7.3) | |
| Services | 5,526 (31.4) | 5,155 (32.1) | 252 (24.6) | 70 (22.9) | 49 (23.8) | |
| Transportation, warehousing, and utilities | 1,158 (6.6) | 1,076 (6.7) | 62 (6.1) | 12 (3.9) | 8 (3.9) | |
| Wholesale and retail trade | 3,230 (18.3) | 3,024 (18.8) | 143 (14.0) | 36 (11.8) | 27 (13.1) | |
| **Occupation** (n=17,036) | | | | | | <.0001 |
| Management, business, science, and arts | 1,706 (10.0) | 1,595 (10.3) | 80 (8.1) | 17 (5.7) | 14 (6.9) | |
| Services | 4,538 (26.6) | 4,194 (27.0) | 251 (25.3) | 63 (21.2) | 31 (15.4) | |
| Sales and office | 1,646 (9.7) | 1,553 (10.0) | 65 (6.6) | 18 (6.1) | 10 (5.0) | |
| Natural resources, construction, and maintenance | 4,471 (24.2) | 3,881 (25.0) | 349 (35.3) | 140 (47.1) | 101 (50.0) | |
| Production, transportation, and material moving | 4,675 (27.4) | 4,324 (27.8) | 246 (24.9) | 59 (19.9) | 46 (22.8) | |

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Table 2.4. Summary statistics for Travel Distance (in miles) to Nearest Physical Therapist by Urban and Rural Categories (N=47,785)

| Summary Statistics for travel distance (miles) | Urban area, n=41,109 | Large rural city or town, n=4,058 | Small rural town, n=1,682 | Isolated small town, n=936 |
|---|---|---|---|---|
| Mean | 2.0 | 3.9 | 15.5 | 15.3 |
| Median | 1.2 | 2.2 | 11.4 | 10.6 |
| 25th percentile (Q1) | 0.7 | 0.8 | 2.2 | 2.3 |
| 75th percentile (Q3) | 2.1 | 5.4 | 24.1 | 24.6 |
| 90th percentile | 4.2 | 9.5 | 40.6 | 40.4 |
| 95th percentile | 7.0 | 13.9 | 41.1 | 43.1 |
| Minimum | <0.1 | <0.1 | <0.1 | <0.1 |
| Maximum | 50.3 | 40.6 | 78.1 | 71.0 |

Abbreviations: Q=quartile

Table 2.5. Adjusted Estimates (β) and 95% Confidence Intervals (CI) for Travel Distance to Physical Therapy Provider by Rural and Urban Categories, (N=47,785)

| Travel distance to a PT provider (miles) | Estimate (β) Miles | 95%CI | | *p-value* |
|---|---|---|---|---|
| Urban area | Reference | - | - | <.0001 |
| Large rural city or town | 2.0 | 1.8 | 2.1 | |
| Small rural town | 13.5 | 12.8 | 14.2 | |
| Isolated small town | 13.3 | 12.4 | 14.2 | |

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Table 2.6. Adjusted estimates (β) and 95% Confidence Intervals (CI) for Timing (days from injury) to a Physical Therapy Provider by Rural and Urban Categories (N=16,672)

| Characteristic | Estimate (β) Days | 95%CI | | *p-value* |
|---|---|---|---|---|
| **Unadjusted Model** | | | | |
| **Geographical Area** | | | | |
| Urban area | Reference | | | <.0001 |
| Large rural city or town | 22.0 | 17.4 | 26.6 | |
| Small rural town | 16.5 | 9.8 | 23.3 | |
| Isolated small town | 16.5 | 6.9 | 26.2 | |
| **Adjusted Model** | | | | |
| **Geographical Area** | | | | |
| Urban area | Reference | | | <.0001 |
| Large rural city or town | 20.2 | 15.6 | 24.7 | |
| Small rural town | 16.2 | 9.1 | 23.2 | |
| Isolated small town | 18.8 | 8.9 | 28.7 | |
| **Age Group** | | | | |
| 18-24 | Reference | | | <.0001 |
| 25-34 | 4.6 | 2.1 | 7.0 | |
| 35-44 | 7.4 | 4.8 | 10.1 | |
| 45-54 | 11.9 | 9.0 | 14.7 | |
| 55-64 | 16.8 | 13.5 | 20.0 | |
| 65+ | 18.5 | 11.9 | 25.2 | |
| **Sex** | | | | |
| Men | Reference | | | .1447 |
| Women | 1.5 | -0.5 | 3.6 | |
| **Marital Status** | | | | |
| Married | Reference | | | .9883 |
| Single | -0.01 | -1.8 | 1.7 | |
| **Attending Provider** | | | | |
| Physician | Reference | | | <.0001 |
| Physician assistant | -15.5 | -17.2 | -13.8 | |
| Nurse practitioner | -5.9 | -8.3 | -3.5 | |
| Chiropractor | 32.1 | 28.4 | 35.8 | |
| Other | 8.1 | 1.1 | 15.1 | |
| **Traumatic Injury** | | | | |
| Yes | -10.8 | -13.5 | -8.1 | <.0001 |
| No | Reference | | | |
| **Multiple Injury** | | | | |
| Yes | 8.9 | 7.0 | 10.9 | <.0001 |
| No | Reference | | | |

| | | | | |
|---|---|---|---|---|
| **Industry** | | | | |
| Agriculture, forestry, fishing, and mining | 0.8 | -4.4 | 5.9 | <.0001 |
| Construction | Reference | | | |
| Health care and social assistance | -9.5 | -13.7 | -5.4 | |
| Manufacturing | -2.8 | -7.1 | 1.6 | |
| Services | -1.3 | -4.8 | 2.3 | |
| Transportation, warehousing, and utilities | -5.6 | -10.1 | -1.0 | |
| Wholesale and retail trade | -4.2 | -7.9 | -0.4 | |
| **Occupation** | | | | |
| Management, business, science, and arts | 2.7 | -0.4 | 5.7 | .1461 |
| Services | Reference | | | |
| Sales and office | 0.9 | -2.7 | 4.5 | |
| Natural resources, construction, and maintenance | 1.4 | -2.0 | 4.8 | |
| Production, transportation, and material moving | -1.2 | -4.1 | 1.8 | |

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Table 3.1. Baseline Factors for Physical Therapy Use in Each of the Six Domains

| Baseline factors | Data Source | Categories or scores for each measure |
|---|---|---|
| **Socio-demographic** | | |
| Age | Claims | 18-24; 25-34; 35-44; 45-54; 55+ |
| Gender | Claims | Men, Women |
| Race/ethnicity | Survey | White non-Hispanic/Latino; Hispanic/Latino; Other non-Hispanic/Latino |
| Marital status | Survey | Married; living with a partner; divorced/widowed/separated; single |
| Education | Survey | Less than high school degree; high school degree or GED[a]; vocational or some college; college graduate |
| Annual household income | Survey | <$30,000; $30,000-$44,999; $45,000-$69,999; ≥ $70,000 |
| Location of worker residence[b] | Claims | Urban (≥50,000 people); suburban (10,000-49,999 people); large town (2,500-9,999 people); rural (≤2,499 people) by ZIP code |
| **Pain and function** | | |
| Pain intensity in the past week (0-10 scale) | Survey | 0 = no pain; 10 = pain as bad as can be |
| Pain interference with daily activity in the last week (0-10 scale) | Survey | 0 = no pain; 10 = pain as bad as can be |
| Pain interference with work in the last week (0-10 scale) | Survey | 0 = no pain; 10 = pain as bad as can be |
| RMDQ disability score [a] (0-24 scale) | Survey | Higher scores indicate greater disability |
| SF-36v2 physical function[a] (0-60 scale) | Survey | Lower values indicate poorer function |
| SF-36v2 role physical[a] (0-60 scale) | Survey | Lower values indicate poorer function |
| Injury severity | Medical Review | Mild sprain/strain; major sprain/strain; evidence of radiculopathy; severe immobility including loss of reflexes, bladder complaints, and motor abnormalities |
| **Psychosocial** | | |
| Catastrophizing (0-4 scale) | Survey | 0 = no thoughts about pain; 4 = thinking about pain all the time |
| Recovery expectations (0-10 scale) | Survey | Very high (10); high (7-9); low (0-6) |
| Fear avoidance composite score (0-6 scale) | Survey | Disagree (0-1.9); neutral (2-3.9); agree (4-6) |
| SF-36v2 mental health score in the past week[a] (0-100 scale) | Survey | Higher scores indicate better psychological status |
| **Clinical** | | |
| Body mass index (kg/m$^2$) | Survey | Underweight (<18.5); normal (18.5-24.9); overweight (25-29.9); obese (≥30) |

| | | |
|---|---|---|
| First provider seen for injury | Claims | Primary care; surgeon; physical medicine and rehabilitation; occupational medicine; chiropractor; emergency medicine, and other |
| Previous injury (> 1 month off work) | Survey | Yes; no |
| Number of prior WC[a] claims | Survey | 1-4 |
| Current health status | Survey | Excellent; very good; good; fair/poor |
| **Health behaviors** | | |
| Tobacco use | Survey | No use; occasionally/frequently; daily |
| High risk alcohol use (AUDIT-C)[a] (0-4 scale) | Survey | Higher score indicates heavy drinking and high dependence of alcohol |
| **Employment-related** | | |
| Heavy lifting | Survey | Not at all/rarely/occasionally; frequently; constantly |
| Physical demands | Survey | Sedentary/light; medium; heavy; and very heavy |
| Working very fast | Survey | Strongly disagree/disagree; agree; strongly agree |
| Excessive amount of work | Survey | Strongly disagree/disagree; agree; strongly agree |
| Enough time to get job done | Survey | Strongly disagree/disagree; agree; strongly agree |
| Hectic job | Survey | Strongly disagree/disagree; agree; strongly agree |
| Can take breaks | Survey | Strongly disagree/disagree; agree; strongly agree |
| Supervisor listens | Survey | Strongly disagree/disagree; agree; strongly agree |
| Part-time work | Survey | Part-time, full-time |
| Temporary job | Survey | Yes; no |
| Employer offered accommodations | Survey | Yes; no |
| Industry sector (NORA groups)[a] | Claims | Agriculture, forestry & fishing; Construction; Healthcare & social assistance; Manufacturing; Mining; Oil and gas extraction; Public; Services; Wholesale and retail trade; Transportation, warehousing & utilities |

[a]Abbreviations: GED = General Education Development; RMDQ = Roland Morris Disability Questionnaire; SF-36v2 = The Short Form Health Survey version-2.0; WC = workers' compensation; AUDIT-C = Alcohol Use Disorders Identification Test – Concise; NORA = National Institute for Occupational Safety and Health National Occupational Research Agenda.
[b]By residential ZIP code, using the Washington State Rural/Urban guidelines classifications.

## Table 3.2. Baseline Factors for Workers with Back Injuries, by Physical Therapy Use (N=1,370)

| Baseline factors | All Claims (N=1,370) | Physical Therapy Use | | *P*-value |
|---|---|---|---|---|
| | | Yes (n=673) | No (n=697) | |
| **Socio-demographics** | Number (%) / Mean (SD) | | | |
| Age, years: 18-24 | 142 (10.4) | 58 (8.6) | 84 (12.1) | 0.06 |
| 25-34 | 355 (25.9) | 164 (24.4) | 191 (27.4) | |
| 35-44 | 392 (28.6) | 201 (29.9) | 191 (27.4) | |
| 45-54 | 339 (24.7) | 183 (27.2) | 156 (22.4) | |
| 55+ | 142 (10.4) | 67 (10.0) | 75 (10.8) | |
| Gender: Women | 437 (32.0) | 243 (36.1) | 197 (27.8) | <0.01 |
| Men | 933 (68.1) | 430 (63.9) | 503 (72.2) | |
| Race/ethnicity: White non-Hispanic/Latino | 971 (70.9) | 502 (74.6) | 469 (67.3) | <0.01 |
| Hispanic/Latino | 210 (15.3) | 85 (12.6) | 125 (17.9) | |
| Other non-Hispanic/Latino | 189 (13.8) | 86 (12.8) | 103 (14.8) | |
| Marital status: Married | 699 (51.1) | 361 (53.6) | 338 (48.7) | 0.13 |
| Living with a partner | 202 (14.8) | 90 (13.4) | 112 (16.1) | |
| Divorced/Separated/Widowed | 264 (19.3) | 133 (19.8) | 131 (18.9) | |
| Single | 202 (14.8) | 89 (13.2) | 113 (16.3) | |
| Education: Less than high school | 169 (12.3) | 90 (13.4) | 79 (11.3) | 0.61 |
| High school graduate or GED[a] | 459 (33.5) | 220 (32.7) | 239 (34.3) | |
| Vocational or some college | 623 (45.5) | 308 (45.8) | 315 (45.2) | |
| College graduate | 119 (8.7) | 55 (8.2) | 64 (9.2) | |
| Annual household income: <$30,000 | 533 (40.2) | 235 (36.3) | 298 (44.0) | 0.04 |
| $30,000-$44,999 | 348 (26.3) | 183 (28.3) | 165 (24.3) | |
| $45,000-$69,999 | 323 (24.4) | 164 (25.4) | 159 (23.5) | |
| ≥ $70,000 | 121 (9.1) | 65 (10.1) | 56 (8.3) | |
| Location of worker residence[b]: Urban | 807 (60.6) | 388 (60.0) | 419 (61.3) | <0.01 |
| Suburban | 215 (16.2) | 125 (19.3) | 90 (13.2) | |
| Large town | 166 (12.5) | 70 (10.8) | 96 (14.0) | |
| Rural | 143 (10.7) | 64 (9.9) | 79 (11.6) | |
| **Pain and Function** | | | | |
| Pain intensity, Mean (SD) | 5.4 (2.6) | 5.9 (2.3) | 4.78 (2.7) | <0.01 |
| Pain interference with daily activity, Mean (SD) | 5.1 (3.0) | 6.1 (2.6) | 4.2 (3.0) | <0.01 |
| Pain interference with work, Mean (SD) | 5.2 (3.3) | 6.3 (2.9) | 4.2 (3.2) | <0.01 |
| RMDQ disability score, Mean (SD) | 12.9 (6.9) | 15.2 (6.1) | 10.6 (7.0) | <0.01 |
| SF-36v2 physical function[a], Mean (SD) | 38.0 (12.5) | 33.8 (11.9) | 42.1 (11.6) | <0.01 |
| SF-36v2 role physical[a], Mean (SD) | 37.0 (12.7) | 31.9 (11.6) | 42.0 (11.9) | <0.01 |
| Injury severity[c]: Mild sprain/strain | 771 (56.5) | 301 (44.8) | 470 (67.8) | <0.01 |
| Major sprain/strain | 291 (21.3) | 165 (24.6) | 126 (18.2) | |
| Evidence of radiculopathy | 258 (18.9) | 173 (25.7) | 85 (12.3) | |
| Severe immobility | 45 (3.3) | 33 (4.9) | 12 (1.7) | |
| **Psychosocial** | | | | |
| Catastrophizing, Mean (SD) | 1.9 (1.1) | 2.1 (1.1) | 1.6 (1.1) | <0.01 |
| Recovery expectations: Very high | 791 (59.4) | 345 (52.9) | 446 (65.7) | <0.01 |
| High | 273 (20.5) | 142 (21.8) | 1131 (19.3) | |
| Low | 267 (20.1) | 165 (25.3) | 102 (15.0) | |
| Fear avoidance composite score: Disagree | 50 (3.6) | 20 (3.0) | 30 (4.3) | <0.01 |
| Neutral | 655 (48.0) | 273 (40.7) | 382 (55.0) | |
| Agree | 661 (48.4) | 378 (56.3) | 283 (40.7) | |
| SF-36v2 mental health score[a], Mean (SD) | 70.0 (23.4) | 60.6 (24.0) | 70.9 (21.6) | <0.01 |
| **Clinical** | | | | |
| Body mass index: Underweight | 9 (0.7) | 2 (0.3) | 7 (1.03) | 0.02 |
| Normal | 407 (30.4) | 180 (27.4) | 227 (33.3) | |
| Overweight | 521 (39.0) | 258 (39.3) | 263 (38.6) | |
| Obese | 400 (29.9) | 216 (32.9) | 184 (27.0) | |
| First provider seen for injury: Primary care | 489 (35.7) | 277 (41.2) | 212 (30.4) | <0.01 |
| Surgeon | 117 (8.5) | 99 (14.7) | 18 (2.6) | |
| Physical medicine/rehabilitation | 90 (6.6) | 71 (11.1) | 15 (2.2) | |
| Occupational medicine | 93 (6.8) | 65 (9.7) | 28 (4.0) | |
| Chiropractor | 386 (28.2) | 84 (12.5) | 302 (43.3) | |
| Emergency medicine | 30 (2.2) | 4 (0.6) | 26 (3.7) | |
| Other | 165 (12.0) | 69 (10.3) | 96 (13.8) | |

| | | | | |
|---|---|---|---|---|
| Previous injury: Yes | 355 (26.0) | 207 (30.9) | 148 (21.3) | <0.01 |
| No | 1,009 (74.0) | 463 (69.1) | 546 (78.7) | |
| Number of prior WC[a] claims, Mean (SD) | 1.4 (2.2) | 1.5 (2.3) | 1.3 (2.13) | 0.04 |
| Current health status: Excellent | 257 (18.8) | 115 (17.2) | 142 (20.4) | 0.45 |
| Very good | 505 (36.9) | 257 (38.4) | 248 (35.6) | |
| Good | 442 (32.3) | 219 (32.7) | 223 (32.0) | |
| Fair/poor | 163 (11.9) | 79 (11.8) | 84 (12.1) | |
| **Health Behaviors** | | | | |
| Tobacco use: No Use | 734 (53.7) | 343 (51.1) | 391 (56.1) | 0.16 |
| Occasionally/frequently | 211 (15.4) | 106 (15.8) | 105 (15.1) | |
| Daily | 423 (30.9) | 222 (33.1) | 201 (28.8) | |
| High risk alcohol use (AUDIC-C)[a] | 2.10 (2.27) | 2.05 (2.24) | 2.15 (2.30) | 0.42 |
| **Employment-Related** | | | | |
| Heavy lifting: Not at all/rarely/occasionally | 648 (47.4) | 302 (44.9) | 346 (49.7) | <0.01 |
| Frequently | 298 (21.8) | 172 (25.6) | 126 (18.1) | |
| Constantly | 422 (30.9) | 198 (29.5) | 224 (32.2) | |
| Physical Demands: Sedentary/light | 264 (19.4) | 124 (18.5) | 140 (20.2) | 0.12 |
| Medium | 445 (32.7) | 206 (30.8) | 239 (34.5) | |
| Heavy | 333 (24.5) | 164 (24.5) | 169 (24.4) | |
| Very heavy | 320 (23.5) | 175 (26.2) | 145 (20.9) | |
| Working very fast: Strongly disagree/disagree | 324 (23.7) | 127 (18.9) | 197 (28.4) | <0.01 |
| Agree | 548 (40.1) | 280 (41.7) | 268 (38.6) | |
| Strongly agree | 494 (36.2) | 264 (39.3) | 230 (33.1) | |
| Excessive amount of work: Strongly disagree/disagree | 600 (44.2) | 253 (37.9) | 347 (50.3) | <0.01 |
| Agree | 460 (33.9) | 247 (37.0) | 213 (30.9) | |
| Strongly agree | 298 (21.9) | 168 (25.2) | 130 (18.8) | |
| Enough time to get job done: Strongly disagree/disagree | 371 (27.2) | 212 (31.7) | 159 (22.9) | <0.01 |
| Agree | 809 (59.4) | 375 (56.1) | 434 (62.6) | |
| Strongly agree | 182 (13.4) | 82 (12.3) | 100 (14.4) | |
| Hectic job: Strongly disagree/disagree | 374 (27.5) | 154 (23.0) | 220 (31.8) | 0.01 |
| Agree | 608 (44.7) | 290 (43.3) | 318 (46.0) | |
| Strongly agree | 379 (27.9) | 226 (33.7) | 153 (22.1) | |
| Can take breaks: Strongly disagree/disagree | 715 (52.5) | 375 (56.0) | 340 (49.1) | 0.03 |
| Agree | 528 (38.7) | 244 (36.4) | 284 (41.0) | |
| Strongly agree | 120 (8.8) | 51 (7.6) | 69 (10.0) | |
| Supervisor listens: Strongly disagree/disagree | 259 (19.2) | 151 (22.8) | 108 (15.7) | <0.01 |
| Agree | 782 (57.9) | 361 (54.6) | 421 (61.0) | |
| Strongly agree | 310 (23.0) | 149 (22.5) | 161 (23.3) | |
| Part-time work | 124 (9.1) | 53 (7.9) | 71 (10.2) | 0.14 |
| Full-time | 1,245 (90.9) | 619 (92.1) | 626 (89.8) | |
| Temporary job: Yes | 84 (6.1) | 35 (5.2) | 49 (7.0) | 0.16 |
| No | 1,283 (94.9) | 635 (94.8) | 648 (93.0) | |
| Employer offered accommodations: Yes | 645 (47.8) | 293 (44.3) | 352 (51.1) | 0.01 |
| No | 705 (52.2) | 368 (55.7) | 337 (48.9) | |
| Industry sector (NORA groups)[a]: Wholesale & retail trade | 263 (19.2) | 110 (16.3) | 153 (22.0) | 0.15 |
| Agriculture, forestry & fishing | 62 (4.5) | 24 (3.6) | 38 (5.5) | |
| Construction | 236 (17.2) | 122 (18.1) | 114 (16.4) | |
| Healthcare & social assistance | 190 (13.9) | 105 (15.6) | 85 (12.2) | |
| Manufacturing | 105 (7.7) | 49 (7.3) | 56 (8.0) | |
| Mining | 3 (0.2) | 1 (0.2) | 2 (0.3) | |
| Oil and gas extraction | 2 (0.2) | 1 (0.2) | 1 (0.1) | |
| Public safety | 24 (1.8) | 13 (1.9) | 11 (1.6) | |
| Services | 391 (28.5) | 199 (29.6) | 192 (27.6) | |
| Transportation, warehousing & utilities | 94 (6.9) | 49 (7.3) | 45 (6.5) | |

[a]Abbreviations: OR = odds ratio; 95%CI = 95% confidence interval; GED = General Education Development; SD = standard deviation; RMDQ = Roland Morris Disability Questionnaire; SF-36v2 = the Short Form Health Survey version-2.0; WC = workers' compensation; AUDIT-C = Alcohol Use Disorders Identification Test – Concise; NORA = National Institute for Occupational Safety and Health National Occupational Research Agenda.

[b]By residential ZIP code, using the Washington State Rural/Urban guidelines classifications.

[c]Worker medical records were reviewed to determine the injury severity rating based on a previous studies.[73,101]

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Table 3.3. Unadjusted and adjusted associations between baseline socio-demographic factors and physical therapy use among workers with back pain (N=1,370)[a]

| Baseline socio-demographic factors | Unadjusted OR (95%CI) | *P*-value | Adjusted OR (95%CI) | *P*-value |
|---|---|---|---|---|
| Age, years | | 0.06 | | 0.88 |
| 18-24 | 0.66 (0.44-0.97) | | 0.80 (0.51-1.25) | |
| 25-34 | 0.82 (0.61-1.09) | | 0.91 (0.67-1.25) | |
| 35-44 | Reference | | Reference | |
| 45-54 | 1.11 (0.83-1.49) | | 1.14 (0.84-1.56) | |
| 55+ | 0.85 (0.58-1.25) | | 0.78 (0.51-1.18) | |
| Gender | | <0.01 | | <0.01 |
| Women | Reference | | Reference | |
| Men | 0.68 (0.54-0.86) | | 0.62 (0.48 -0.80) | |
| Race/ethnicity | | <0.01 | | 0.15 |
| White non-Hispanic/Latino | Reference | | Reference | |
| Hispanic/Latino | 0.64 (0.47-0.86) | | 0.68 (0.48-0.97) | |
| Other non-Hispanic/Latino | 0.78 (0.57-1.07) | | 0.90 (0.65-1.26) | |
| Marital status | | 0.13 | | 0.29 |
| Married | Reference | | Reference | |
| Living with a partner | 0.75 (0.55-1.03) | | 0.74 (0.52-1.04) | |
| Divorced/separated/widowed | 0.95 (0.72-1.26) | | 0.96 (0.70-1.32) | |
| Single | 0.74 (0.54-1.01) | | 0.83 (0.57-1.20) | |
| Education | | 0.61 | | 0.48 |
| Less than high school | 1.24 (0.87-1.76) | | 1.53 (1.03-2.26) | |
| High School graduate or GED[b] | Reference | | Reference | |
| Vocational or some college | 1.06 (0.83-1.35) | | 0.99 (0.76-1.28) | |
| College graduate | 0.93 (0.62-1.40) | | 0.79 (0.51-1.21) | |
| Annual household income | | 0.04 | | 0.02 |
| < $30,000 | Reference | | Reference | |
| $30,000-$44,999 | 1.41 (1.07-1.84) | | 1.38 (1.03-1.86) | |
| $45,000-$69,999 | 1.31 (0.99-1.73) | | 1.27 (0.92-1.76) | |
| ≥ $70,000 | 1.47 (0.99-2.19) | | 1.51 (0.97- 2.36) | |
| Location of worker residence[c] | | <0.01 | | 0.26 |
| Urban | Reference | | Reference | |
| Suburban | 1.50 (1.10-2.03) | | 1.51 (1.10-2.08) | |
| Large town | 0.79 (0.56-1.10) | | 0.78 (0.55-1.11) | |
| Rural | 0.87 (0.61-1.25) | | 0.81 (0.56-1.18) | |

[a]Models were adjusted for all baseline factors included in this table.
[b]Abbreviations: OR = odds ratio; 95%CI = 95% confidence interval; GED = General Education Development.
[c]By residential ZIP code, using the Washington State Rural/Urban guidelines classifications.

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## Table 3.4. Unadjusted and adjusted associations between baseline clinical and health factors and physical therapy use among workers with back pain (N=1,370)[a]

| Baseline factors | Unadjusted OR (95%CI) | *P*-value | Adjusted OR (95%CI) | *P*-value |
|---|---|---|---|---|
| **Pain and Function** | | | | |
| Pain intensity | 1.20 (1.15-1.26) | <0.01 | 1.20 (1.15-1.26) | <0.01 |
| Pain interference with daily activity in the last week | 1.25 (1.20-1.30) | <0.01 | 1.24 (1.19-1.29) | <0.01 |
| Pain interference with work in the last week | 1.23 (1.19-1.27) | <0.01 | 1.23 (1.18-1.27) | <0.01 |
| RMDQ disability score [b] | 1.11 (1.09-1.13) | <0.01 | 1.08 (1.04-1.11) | <0.01 |
| SF-36v2 physical function[b] | 0.94 (0.94-0.95) | <0.01 | 0.95 (0.94-0.96) | <0.01 |
| SF-36v2 role physical | 0.93 (0.93-0.94) | <0.01 | 0.94 (0.93-0.95) | <0.01 |
| Injury severity | | <0.01 | | <0.01 |
| Mild sprain/strain | Reference | | Reference | |
| Major sprain/strain | 2.04 (1.56-2.70) | | 1.84 (1.38-2.45) | |
| Evidence of radiculopathy | 3.18 (2.36-4.28) | | 2.99 (2.20-4.05) | |
| Severe immobility | 4.29 (2.18-8.45) | | 4.35 (2.24-8.44) | |
| **Psychosocial** | | | | |
| Catastrophizing | 1.47 (1.33-1.62) | <0.01 | 1.46 (1.32-1.62) | <0.01 |
| Recovery expectations | | <0.01 | | <0.01 |
| Very high | Reference | | Reference | |
| High | 1.40 (1.06-1.85) | | 1.47 (1.10-1.97) | |
| Low | 2.09 (1.57-2.78) | | 2.24 (1.66-3.03) | |
| Fear avoidance composite | | <0.01 | | <0.01 |
| Disagree | Reference | | Reference | |
| Neutral | 1.07 (0.60-1.93) | | 1.16 (0.63-2.15) | |
| Agree | 2.00 (1.11-3.60) | | 2.09 (1.12-3.87) | |
| SF-36v2 mental health score in the past week[b] | 0.98 (0.98-0.99) | <0.01 | 0.98 (0.97-0.98) | <0.01 |
| **Clinical** | | | | |
| Body mass index | | 0.02 | | <0.01 |
| Underweight | 0.36 (0.07-1.76) | | 0.38 (0.09-1.54) | |
| Normal | Reference | | Reference | |
| Overweight | 1.24 (0.95-1.60) | | 1.20 (0.91-1.54) | |
| Obese | 1.48 (1.12-1.95) | | 1.43 (1.07-1.92) | |
| First provider seen for injury | | <0.01 | | <0.01 |
| Primary care | Reference | | Reference | |
| Surgeon | 4.21 (2.47-7.17) | | 4.81 (2.72-8.50) | |
| Physical medicine and rehabilitation | 3.83 (2.14-6.85) | | 3.45 (1.92-6.21) | |
| Occupational medicine | 1.78 (1.10-2.86) | | 2.16 (1.32-3.55) | |
| Chiropractor | 0.21 (0.16-0.29) | | 0.22 (0.16-0.30) | |
| Emergency medicine | 0.12 (0.04-0.34) | | 0.14 (0.05-0.41) | |
| Other | 0.55 (0.38-0.79) | | 0.64 (0.43-0.93) | |
| Previous injury (vs. no previous injury) | 1.65 (1.29-2.11) | <0.01 | 1.69 (1.31-2.19) | <0.01 |
| Number of prior WC claims[b] | 1.05 (0.99-1.11) | 0.06 | 1.06 (0.99-1.12) | 0.06 |
| Current health | | 0.50 | | 0.20 |
| Excellent | Reference | | Reference | |
| Very good | 1.28 (0.95-1.73) | | 1.25 (0.91-1.72) | |
| Good | 1.21 (0.89-1.65) | | 1.25 (0.90-1.73) | |
| Fair/poor | 1.16 (0.78-1.72) | | 1.33 (0.87-2.03) | |
| **Health Behaviors** | | | | |
| Tobacco use | | 0.06 | | 0.07 |
| No use | Reference | | Reference | |
| Occasionally/frequently | 1.15 (0.85-1.56) | | 1.16 (0.84-1.61) | |
| Daily | 1.26 (0.99-1.60) | | 1.26 (0.98-1.63) | |
| High risk alcohol use (AUDIT-C)[b] | 0.98 (0.94-1.03) | 0.42 | 0.99 (0.95-1.05) | 0.91 |

[a]Models were adjusted for age, gender, race/ethnicity, marital status, education, annual household income, and location of worker residence.
[b]Abbreviations: OR = odds ratio; 95%CI = 95% confidence interval; SD = standard deviation; RMDQ = Roland Morris Disability Questionnaire; SF-36v2 = the Short Form Health Survey version-2.0; WC= workers' compensation; AUDIT-C = Alcohol Use Disorders Identification Test – Concise.

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Table 3.5. Unadjusted and adjusted associations between baseline employment-related factors and physical therapy use among workers with back pain (N=1,370)[a]

| Baseline employment-related factors | Unadjusted OR (95%CI)[b] | *P*-value | Adjusted OR (95%CI)[b] | *P*-value |
|---|---|---|---|---|
| Heavy lifting | | 0.02 | | <0.01 |
| Not at all/rarely/occasionally | Reference | | Reference | |
| Frequently | 1.01 (0.79-1.29) | | 1.10 (0.85-1.43) | |
| Constantly | 1.56 (1.19-2.06) | | 1.70 (1.27-2.30) | |
| Physical demands | | 0.06 | | 0.01 |
| Sedentary/light | Reference | | Reference | |
| Medium | 0.97 (0.72-1.32) | | 1.02 (0.74-1.41) | |
| Heavy | 1.10 (0.79-1.51) | | 1.35 (0.95-1.92) | |
| Very heavy | 1.36 (0.98-1.89) | | 1.51 (1.06-2.16) | |
| Working very fast | | <0.01 | | <0.01 |
| Strongly disagree/disagree | Reference | | Reference | |
| Agree | 1.62 (1.23-2.14) | | 1.65 (1.22-2.22) | |
| Strongly agree | 1.78 (1.34-2.37) | | 1.70 (1.26-2.31) | |
| Excessive amount of work | | <0.01 | | <0.01 |
| Strongly disagree/disagree | Reference | | Reference | |
| Agree | 1.59 (1.25-2.03) | | 1.70 (1.32-2.21) | |
| Strongly agree | 1.77 (1.34-2.35) | | 1.73 (1.28-2.32) | |
| Enough time to get job done | | <0.01 | | <0.01 |
| Strongly disagree/disagree | Reference | | Reference | |
| Agree | 0.65 (0.51-0.83) | | 0.63 (0.49-0.81) | |
| Strongly agree | 0.62 (0.43-0.88) | | 0.56 (0.38-0.81) | |
| Hectic job | | 0.01 | | <0.01 |
| Strongly disagree/disagree | Reference | | Reference | |
| Agree | 1.30 (1.00-1.69) | | 1.29 (0.98-1.70) | |
| Strongly agree | 2.11 (1.58-2.82) | | 1.90 (1.40-2.58)) | |
| Can take breaks | | <0.01 | | 0.02 |
| Strongly disagree/disagree | Reference | | Reference | |
| Agree | 0.78 (0.62-0.98) | | 0.80 (0.63-1.02) | |
| Strongly agree | 0.67 (0.45-0.99) | | 0.65 (0.44-0.97) | |
| Supervisor listens | | <0.01 | | <0.01 |
| Strongly disagree/disagree | Reference | | Reference | |
| Agree | 0.61 (0.46-0.81) | | 0.66 (0.49-0.89) | |
| Strongly agree | 0.66 (0.47-0.92) | | 0.63 (0.44-0.89) | |
| Part-time work (vs. full-time) | 0.75 (0.52-1.10 | 0.14 | 0.74 (0.49-1.12) | 0.16 |
| Temporary job (vs. non-temporary) | 0.73 (0.47-1.14) | 0.17 | 0.78 (0.48-1.25) | 0.29 |
| Employer offered accommodations (vs. did not) | 0.76 (0.62-0.94) | 0.01 | 0.75 (0.60-0.94) | 0.01 |
| Industry sector (NORA groups)[b] | | 0.12 | | 0.96 |
| Wholesale & retail trade | Reference | | Reference | |
| Agriculture, forestry & fishing | 0.88 (0.50-1.55) | | 1.09 (0.60-1.99) | |
| Construction | 1.49 (1.04-2.12) | | 1.59 (1.09-2.31) | |
| Healthcare & social assistance | 1.72 (1.18-2.50) | | 1.22 (0.70-2.15) | |
| Manufacturing | 1.22 (0.77-1.92) | | 1.33 (0.86-2.04) | |
| Mining | 0.70 (0.06-7.78) | | 2.24 (0.17-29.3) | |
| Oil and gas extraction | 1.39 (0.09-22.5) | | 1.92 (0.13-28.6) | |
| Public safety | 1.64 (0.71-3.81) | | 1.70 (0.72-4.04) | |
| Services | 1.44 (1.05-1.98) | | 1.40 (1.00-1.96) | |
| Transportation, warehousing & utilities | 1.51 (0.94-2.43) | | 1.56 (0.95-2.56) | |

[a]Models were adjusted for age, gender, race/ethnicity, marital status, education, annual household income, and location of worker residence.
[b]Abbreviations: NORA = National Institute for Occupational Safety and Health National Occupational Research Agenda.

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Table 4.1. Baseline covariates from each of the five domains and time to PT care used for the adjusted models

| Baseline factors | Data Source | Categories or scores for each measure |
|---|---|---|
| **Socio-demographic** | | |
| Age | Claims | 18-24; 25-34; 35-44; 45-54; 55+; (categorical; reference = 35-44) |
| Gender | Claims | Men (0), Women (1); (binary) |
| Race/ethnicity | Survey | White non-Hispanic/Latino; Hispanic/Latino; Other non-Hispanic/Latino; (categorical; reference = White non-Hispanic/Latino) |
| Marital status | Survey | Married; living with a partner; divorced/widowed/separated; single; (categorical; reference = married) |
| Education | Survey | Less than high school degree; high school degree or GED[a]; vocational or some college; college graduate; (categorical; reference = high school degree or GED) |
| Annual household income | Survey | <$30,000; $30,000-$44,999; $45,000-$69,999; ≥ $70,000; (categorical; reference = <$30,000) |
| Location of worker residence[b] | Claims | Urban (≥50,000 people); suburban (10,000-49,999 people); large town (2,500-9,999 people); rural (≤2,499 people) by ZIP code; (categorical; reference = Urban) |
| **Pain and function** | | |
| Pain intensity in the past week (0-10 scale) | Survey | 0 = no pain; 10 = pain as bad as can be; (continuous) |
| RMDQ score[a] (0-24 scale) | Survey | Higher scores indicate greater disability; (continuous) |
| Injury severity | Medical Review | Mild sprain/strain; major sprain/strain; evidence of radiculopathy; severe immobility including loss of reflexes, bladder complaints, and motor abnormalities; (categorical; reference = mild sprain/strain) |
| **Psychosocial** | | |
| Catastrophizing (0-4 scale) | Survey | 0 = no thoughts about pain; 4 = thinking about pain all the time; (categorical; reference = no thoughts about pain) |
| Recovery expectations[c] (0-10 scale) | Survey | Very high (10); high (7-9); low (0-6); (categorical; reference = very high) |
| Work-fear avoidance composite score[d] (0-6 scale) | Survey | Disagree (0-1.9); neutral (2-3.9); agree (4-6); (categorical; reference = agree) |

| | | |
|---|---|---|
| SF-36v2 mental health score in the past week[a] (0-100 scale) | Survey | Higher scores indicate better psychological status; (continuous) |
| **Clinical** | | |
| Body mass index (kg/m$^2$) | Survey | Underweight (<18.5); normal (18.5-24.9); overweight (25-29.9); obese (≥30); (categorical; reference = normal) |
| First provider seen for injury | Claims | Primary care; occupational medicine; physical medicine and rehabilitation; chiropractor; other; (categorical; reference = primary care) |
| Current health status | Survey | Excellent; very good; good; fair/poor; (categorical; reference = excellent) |
| **Employment-related** | | |
| Hectic job | Survey | Strongly disagree/disagree; agree; strongly agree; (categorical; reference = strongly agree) |
| Part-time work | Survey | Part-time (0), full-time (1); (binary) |
| Employer offered accommodations | Survey | Yes (0); no (1); (binary) |
| **Time to PT care[e]** | Claims | Number of calendar days between injury date and initial PT visit; (continuous) |

[a]Abbreviations: GED = General Education Development; RMDQ = Roland Morris Disability Questionnaire; SF-36v2 = The Short Form Health Survey version-2.0; WC = workers' compensation; AUDIT-C = Alcohol Use Disorders Identification Test – Concise; NORA = National Institute for Occupational Safety and Health National Occupational Research Agenda, PT = physical therapy

[b] By residential ZIP code, using the Washington State Rural/Urban guidelines classifications (https://www.ers.usda.gov/data-products/rural-urban-commuting-area-codes.aspx)

[c] Recovery expectations is a measure used to indicate certainty for returning to the job in 6 months of injury date with higher scores indicating greater certainty for returning to work

[d] Work-fear avoidance composite score was generated to indicate the worker's thoughts about how work might harm or cause pain to be worse

[e]Time to PT care was included as a covariate in the adjusted models

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Table 4.2. Baseline characteristics of back-injured workers receiving any physical therapy services within the first year

| Baseline characteristics | All claims (N=662) | |
|---|---|---|
| Socio-demographics | Number or Mean | % or SD[a] |
| Age, years | | |
| 18-24 | 44 | 6.6 |
| 25-34 | 157 | 23.7 |
| 35-44 | 215 | 32.5 |
| 45-54 | 182 | 27.5 |
| 55+ | 64 | 9.7 |
| Sex | | |
| Female | 247 | 37.3 |
| Male | 415 | 62.7 |
| Race/Ethnicity | | |
| White non-Hispanic/Latino | 496 | 74.9 |
| Hispanic/Latino | 82 | 12.4 |
| Other non-Hispanic/Latino | 84 | 12.7 |
| Marital Status | | |
| Married | 365 | 55.1 |
| Living with a partner | 82 | 12.4 |
| Divorced/separated/widowed | 140 | 21.1 |
| Never married | 75 | 11.3 |
| Education | | |
| Less than high school | 73 | 11.0 |
| High school graduate or GED[a] | 214 | 32.3 |
| Vocational or some college | 308 | 46.5 |
| College graduate | 67 | 10.1 |
| Annual household income | | |
| <$30,000 | 165 | 25.9 |
| $30,000-$44,999 | 222 | 34.7 |
| $45,000-$70,000 | 173 | 27.1 |
| Over $70,000 | 78 | 12.2 |
| Residential area of worker | | |
| Urban | 379 | 59.1 |
| Suburban | 132 | 20.6 |
| Large town | 67 | 10.5 |
| Rural | 63 | 9.8 |
| Pain and Function | | |
| Pain intensity in the past week, Mean, SD[a] | 5.9 | 2.3 |
| RMDQ score, Mean, SD[a] | 15.0 | 6.1 |
| Injury severity | | |

| | | |
|---|---|---|
| Mild sprain or strain | 282 | 42.6 |
| Major sprain without evidence of nerve injury or radiculopathy | 158 | 23.9 |
| Evidence of radiculopathy | 187 | 28.3 |
| Reflexes absent, bladder complaints, or motor abnormalities | 34 | 5.1 |
| Psychosocial Factors | | |
| Catastrophizing, Mean, SD[a] | 2.1 | 1.1 |
| Work-fear avoidance composite score | | |
| Disagree | 17 | 2.6 |
| Neutral | 272 | 41.1 |
| Agree | 372 | 56.3 |
| Recovery expectations | | |
| Very high | 338 | 52.6 |
| High | 144 | 22.4 |
| Low | 160 | 24.9 |
| SF-36 Mental Health in the past week, Mean, SD[a] | 41.5 | 13.2 |
| Clinical | | |
| Body mass index | | |
| Normal/underweight | 170 | 25.7 |
| Overweight | 252 | 38.1 |
| Obese | 225 | 34.0 |
| First provider seen for injury | | |
| Primary care | 257 | 38.8 |
| Occupational Medicine | 59 | 8.9 |
| Physical medicine/rehabilitation services | 83 | 12.5 |
| Chiropractor | 104 | 15.7 |
| Other provider | 159 | 24.0 |
| Current health status | | |
| Excellent | 118 | 17.9 |
| Very good | 255 | 38.6 |
| Good | 217 | 32.9 |
| Fair/poor | 70 | 10.6 |
| Previous injury >1 month off work | | |
| No | 449 | 68.1 |
| Yes | 210 | 31.8 |
| Employment-Related | | |
| Job very hectic | | |
| Strongly disagree/disagree | 149 | 22.6 |
| Agree | 304 | 46.1 |
| Strongly agree | 206 | 31.3 |
| Part-time work | | |

| | | |
|---|---|---|
| Full-time | 610 | 92.3 |
| Part-time | 51 | 7.7 |
| Employer offered accommodations | | |
| Yes | 366 | 56.1 |
| No | 287 | 43.9 |

[a]Abbreviations: SD = standard deviation; GED=General Education Development; RMDQ = Roland Morris Disability Questionnaire; SF-36v2 = The Short Form Health Survey version-2.0

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Table 4.3. Distribution of intensity of PT treatments within 28 days of the first PT visit among back-injured workers receiving PT services (N=662)[a]

| Descriptive statistics | Time to first PT visit (days) | Active PT codes | Passive PT codes | Manual Therapy codes | Total number of PT codes | Total number of PT days |
|---|---|---|---|---|---|---|
| Mean (SD)[a] | 47 (62.2) | 10 (9) | 5 (6) | 4 (5) | 20 (12) | 7 (3) |
| Median, (range) | 21 (0-355) | 8 (0-66) | 3 (0-58) | 3 (0-51) | 19 (1-79) | 7 (1-20) |
| 25$^{th}$ percentile (Q1)[a] | 9 | 3 | 0 | 0 | 11 | 4 |
| 75$^{th}$ percentile (Q3)[a] | 54 | 14 | 8 | 7 | 28 | 9 |
| Interquartile range (Q3-Q1)[a] | 45 | 11 | 8 | 7 | 17 | 5 |

[a]Abbreviations: SD = standard deviation;Q1= quartile 1; Q3 = quartile 3

Table 4.4. Logistic regression models examining the association between total intensity of PT treatments and work disability at 1-year follow-up (N=574)[a]

| | | Work disability at 1-year follow-up | | | |
|---|---|---|---|---|---|
| | PT Intensity | Unadjusted OR (95%CI)[b] | *P*-value | Adjusted OR (95%CI)[b] | *P*-value |
| Model 4.1 | Type of PT treatment[c] | | | | |
| | Active PT | 1.01 (0.99-1.03) | 0.58 | 0.99 (0.97-1.02) | 0.77 |
| | Passive PT | 1.01 (0.99-1.04) | 0.33 | 0.99 (0.96-1.03) | 0.68 |
| | Manual Therapy | 1.03 (1.00-1.07) | 0.04 | 1.04 (0.99-1.09) | 0.09 |
| Model 4.2 | Total PT codes | 1.01 (0.99-1.03) | 0.08 | 1.00 (0.98-1.02) | 0.71 |
| Model 4.3 | Total PT days | 1.07 (1.02-1.13) | 0.01 | 1.04 (0.96-1.11) | 0.34 |

[a]Models were adjusted for time to first PT visit, age, sex, marital status, education, race/ethnicity, annual household income, residential area of the worker, pain intensity, RMDQ score, injury severity, catastrophizing, work-fear avoidance, recovery expectations, SF-36 mental health score, body mass index, current health status, first provider seen after injury, previous injury leading to > 1 month off work, hectic job, full-time work, and employer offered accommodations
[b]Abbreviations: OR = odds ratio; 95%CI = 95% confidence interval
[c]Type of PT treatment is categorized as three separate measures for the total number of Active PT, Passive PT, and Manual therapy procedures within 28 days of first PT visit

**Table 4.5. Logistic regression models examining the association between total intensity of PT treatments and working for pay at 1-year follow-up (N=574)[a]**

| | | Working for Pay at 1-year follow-up | | | |
|---|---|---|---|---|---|
| | PT Intensity | Unadjusted OR (95%CI)[b] | *P*-value | Adjusted OR (95%CI)[b] | *P*-value |
| Model 5.1 | Type of PT treatment[c] | | | | |
| | Active PT | 0.96 (0.94-0.98) | <0.01 | 0.97 (0.9-0.99) | 0.04 |
| | Passive PT | 0.98 (0.95-1.00) | 0.05 | 1.00 (0.97-1.04) | 0.84 |
| | Manual Therapy | 0.97 (0.94-1.00) | 0.09 | 0.97 (0.93-1.02) | 0.23 |
| Model 5.2 | Total PT codes | 0.97 (0.96-0.98) | <0.01 | 0.98 (0.96-1.00) | 0.07 |
| Model 5.3 | Total PT days | 0.88 (0.84-0.93) | <0.01 | 0.93 (0.87-1.00) | 0.07 |

[a]Models were adjusted for time to first PT visit, age, sex, marital status, education, race/ethnicity, annual household income, residential area of the worker, pain intensity, RMDQ score, injury severity, catastrophizing, work-fear avoidance, recovery expectations, SF-36 mental health score, body mass index, current health status, first provider seen after injury, previous injury leading to > 1 month off work, hectic job, full-time work, and employer offered accommodations
[b]Abbreviations: OR = odds ratio; 95%CI = 95% confidence interval

[c]Type of PT treatment is categorized as three separate measures for the total number of Active PT, Passive PT, and Manual therapy procedures within 28 days of first PT visit

**Table 4.6. Multiple linear regression models examining the association between total intensity of PT treatments and pain intensity score at 1-year follow-up (N=574)[a]**

| | | Pain intensity score at 1-year follow-up | | | |
|---|---|---|---|---|---|
| | PT Intensity | Unadjusted Estimate (β) (95%CI)[b] | *P*-value | Adjusted Estimate (β) (95%CI))[b] | *P*-value |
| Model 6.1 | Type of PT treatment[c] | | | | |
| | Active PT | -0.01 (-0.03, 0.02) | 0.47 | -0.03 (-0.05, -0.01) | 0.02 |
| | Passive PT | 0.01 (-0.03, 0.04) | 0.70 | -0.01 (-0.04, 0.02) | 0.59 |
| | Manual Therapy | 0.01 (-0.04, 0.05) | 0.80 | -0.01 (-0.04, 0.04) | 0.98 |
| Model 6.2 | Total PT codes | -0.01 (-0.02, 0.01) | 0.78 | -0.02 (-0.03, -0.01) | 0.04 |
| Model 6.3 | Total PT days | -0.01 (-0.07, 0.06) | 0.91 | -0.06 (-0.12, -0.01) | 0.04 |

[a]Models were adjusted for time to first PT visit, age, sex, marital status, education, race/ethnicity, annual household income, residential area of the worker, pain intensity, RMDQ score, injury severity, catastrophizing, work-fear avoidance, recovery expectations, SF-36 mental health score, body mass index, current health status, first provider seen after injury, previous injury leading to > 1 month off work, hectic job, full-time work, and employer offered accommodations
[b]Abbreviations: OR = odds ratio; 95%CI = 95% confidence interval
[c]Type of PT treatment is categorized as three separate measures for the total number of Active PT, Passive PT, and Manual therapy procedures within 28 days of first PT visit

**Table 4.7. Multiple linear regression models examining the association between total intensity of PT treatments and RMDQ score at 1-year follow-up (N=574)[a]**

| | | RMDQ score at 1-year follow-up | | | |
|---|---|---|---|---|---|
| | PT Intensity | Unadjusted Estimate (β) (95%CI)[b] | *P*-value | Adjusted Estimate (β) (95%CI)[b] | *P*-value |
| Model 7.1 | Type of PT treatment[c] | | | | |
| | Active PT | -0.02 (-0.10, 0.04) | 0.41 | -0.07 (-0.13, -0.02) | 0.01 |
| | Passive PT | 0.07 (-0.02, 0.15) | 0.14 | 0.02 (-0.04, 0.09) | 0.41 |
| | Manual Therapy | -0.02 (-0.12, 0.09) | 0.78 | -0.11 (-0.20, -0.01) | 0.03 |
| Model 7.2 | Total PT codes | -0.01 (-0.05, 0.05) | 0.99 | -0.04 (-0.08, -0.01) | 0.02 |
| Model 7.3 | Total PT days | 0.05 (-0.12, 0.22) | 0.57 | -0.16 (-0.29, -0.01) | 0.04 |

[a]Models were adjusted for time to first PT visit, age, sex, marital status, education, race/ethnicity, annual household income, residential area of the worker, pain intensity, RMDQ score, injury severity, catastrophizing, work-fear avoidance, recovery expectations, SF-36 mental health score, body mass index, current health status, first provider seen after injury, previous injury leading to > 1 month off work, hectic job, full-time work, and employer offered accommodations

[b]Abbreviations: OR = odds ratio; 95%CI = 95% confidence interval

[c]Type of PT treatment is categorized as three separate measures for the total number of Active PT, Passive PT, and Manual therapy procedures within 28 days of first PT visit

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BIBLIOGRAPHY


1. Yang H, Haldeman S, Lu M-L, Baker D. Low back pain prevalence and related workplace psychosocial risk factors: a study using data from the 2010 National Health Interview Survey. *Journal of manipulative and physiological therapeutics*. 2016;39(7):459-472.
2. Guo H-R. Working hours spent on repeated activities and prevalence of back pain. *Occupational and environmental medicine*. 2002;59(10):680-688.
3. Ricci JA, Stewart WF, Chee E, Leotta C, Foley K, Hochberg MC. Back pain exacerbations and lost productive time costs in United States workers. *Spine*. 2006;31(26):3052-3060.
4. Stewart WF, Ricci JA, Chee E, Morganstein D, Lipton R. Lost productive time and cost due to common pain conditions in the US workforce. *Jama*. 2003;290(18):2443-2454.
5. Carey TS, Garrett J, Jackman A, et al. The outcomes and costs of care for acute low back pain among patients seen by primary care practitioners, chiropractors, and orthopedic surgeons. *New England journal of medicine*. 1995;333(14):913-917.
6. Chou R, Qaseem A, Snow V, et al. Diagnosis and Treatment of Low Back Pain: A Joint Clinical Practice Guideline from the American College of Physicians and the American Pain SocietyDiagnosis and Treatment of Low Back Pain. *Annals of internal medicine*. 2007;147(7):478-491.
7. Freburger JK, Carey TS, Holmes GM. Physical therapy for chronic low back pain in North Carolina: overuse, underuse, or misuse? *Physical therapy*. 2011;91(4):484-495.
8. Freburger JK, Holmes GM, Agans RP, et al. The rising prevalence of chronic low back pain. *Archives of internal medicine*. 2009;169(3):251-258.
9. Deyo RA, Mirza SK, Martin BI. Back pain prevalence and visit rates: estimates from US national surveys, 2002. *Spine*. 2006;31(23):2724-2727.
10. Licciardone JC. The epidemiology and medical management of low back pain during ambulatory medical care visits in the United States. *Osteopathic Medicine and Primary Care*. 2008;2(1):11.
11. Katz JN. Lumbar disc disorders and low-back pain: socioeconomic factors and consequences. *JBJS*. 2006;88(suppl_2):21-24.
12. Martin BI, Deyo RA, Mirza SK, et al. Expenditures and health status among adults with back and neck problems. *Jama*. 2008;299(6):656-664.
13. Yelin E, Cisternas MG, Pasta DJ, Trupin L, Murphy L, Helmick CG. Medical care expenditures and earnings losses of persons with arthritis and other rheumatic conditions in the United States in 1997: total and incremental estimates. *Arthritis & Rheumatology*. 2004;50(7):2317-2326.
14. Crow WT, Willis DR. Estimating cost of care for patients with acute low back pain: a retrospective review of patient records. *The Journal of the American Osteopathic Association*. 2009;109(4):229-233.
15. Luo X, Pietrobon R, Hey L. Patterns and trends in opioid use among individuals with back pain in the United States. *Spine*. 2004;29(8):884-890.
16. Gray DT, Deyo RA, Kreuter W, et al. Population-based trends in volumes and rates of ambulatory lumbar spine surgery. *Spine*. 2006;31(17):1957-1963.

17. Carrino JA, Morrison WB, Parker L, Schweitzer ME, Levin DC, Sunshine JH. Spinal injection procedures: volume, provider distribution, and reimbursement in the US medicare population from 1993 to 1999. *Radiology*. 2002;225(3):723-729.
18. Martell BA, o'Connor PG, Kerns RD, et al. Systematic review: opioid treatment for chronic back pain: prevalence, efficacy, and association with addiction. *Annals of internal medicine*. 2007;146(2):116-127.
19. Webster BS, Cifuentes M. Relationship of early magnetic resonance imaging for work-related acute low back pain with disability and medical utilization outcomes. *Journal of occupational and environmental medicine*. 2010;52(9):900-907.
20. Franklin GM, Stover BD, Turner JA, Fulton-Kehoe D, Wickizer TM. Early opioid prescription and subsequent disability among workers with back injuries: the Disability Risk Identification Study Cohort. *Spine*. 2008;33(2):199-204.
21. Graves JM, Fulton-Kehoe D, Jarvik JG, Franklin GM. Health care utilization and costs associated with adherence to clinical practice guidelines for early magnetic resonance imaging among workers with acute occupational low back pain. *Health services research*. 2014;49(2):645-665.
22. Jarvik JG, Hollingworth W, Martin B, et al. Rapid magnetic resonance imaging vs radiographs for patients with low back pain: a randomized controlled trial. *Jama*. 2003;289(21):2810-2818.
23. Gilbert FJ, Grant AM, Gillan MG, et al. Low back pain: influence of early MR imaging or CT on treatment and outcome—multicenter randomized trial. *Radiology*. 2004;231(2):343-351.
24. Dowell D, Haegerich TM, Chou R. CDC guideline for prescribing opioids for chronic pain—United States, 2016. *Jama*. 2016;315(15):1624-1645.
25. Qaseem A, Wilt TJ, McLean RM, Forciea MA. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of PhysiciansNoninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain. *Annals of internal medicine*. 2017;166(7):514-530.
26. Assendelft W, Morton SC, Yu EI, Suttorp MJ, Shekelle PG. Spinal manipulative therapy for low back pain. *Cochrane database syst Rev*. 2004;1(1)
27. Hayden JA, Van Tulder MW, Tomlinson G. Systematic review: strategies for using exercise therapy to improve outcomes in chronic low back pain. *Annals of internal medicine*. 2005;142(9):776-785.
28. Schonstein E, Kenny D, Keating J, Koes B, Herbert R. Physical conditioning programs for workers with back and neck pain: a cochrane systematic review. *Spine*. 2003;28(19):E391-E395.
29. Pengel HM, Maher CG, Refshauge KM. Systematic review of conservative interventions for subacute low back pain. *Clinical rehabilitation*. 2002;16(8):811-820.
30. Furlan AD, Brosseau L, Imamura M, Irvin E. Massage for low-back pain: a systematic review within the framework of the Cochrane Collaboration Back Review Group. *Spine*. 2002;27(17):1896-1910.
31. Guzmán J, Esmail R, Karjalainen K, Malmivaara A, Irvin E, Bombardier C. Multidisciplinary rehabilitation for chronic low back pain: systematic review. *Bmj*. 2001;322(7301):1511-1516.
32. Chevan J, Riddle DL. Factors associated with care seeking from physicians, physical therapists, or chiropractors by persons with spinal pain: a population-based study. *journal of orthopaedic & sports physical therapy*. 2011;41(7):467-476.

33. T Slifkin R. Developing Policies Responsive to Barriers to Health Care Among Rural Residents: WhatDo We Need to Know? *The Journal of Rural Health*. 2002;18(5):233-241.
34. Rosenblatt RA, Hart LG. Physicians and rural America. *Western Journal of Medicine*. 2000;173(5):348.
35. Hartley D. Rural health disparities, population health, and rural culture. *American Journal of Public Health*. 2004;94(10):1675-1678.
36. Blumenthal SJ, Kagen J. The effects of socioeconomic status on health in rural and urban America. *Jama*. 2002;287(1):109-109.
37. Hartley D, Quam L, Lurie N. Urban and rural differences in health insurance and access to care. *The Journal of Rural Health*. 1994;10(2):98-108.
38. Hart LG, Larson EH, Lishner DM. Rural definitions for health policy and research. *American journal of public health*. 2005;95(7):1149-1155.
39. National Center for Health Statistics N. State Variability in Supply of Office-based Primary Care Providers: United States, 2012
https://www.cdc.gov/nchs/products/databriefs/db151.htm
40. Ricketts TC. *Rural health in the United States*. Oxford University Press; 1999.
41. Syed ST, Gerber BS, Sharp LK. Traveling towards disease: transportation barriers to health care access. *Journal of community health*. 2013;38(5):976-993.
42. Probst JC, Laditka SB, Wang J-Y, Johnson AO. Effects of residence and race on burden of travel for care: cross sectional analysis of the 2001 US National Household Travel Survey. *BMC Health Services Research*. 2007;7(1):40.
43. Arcury TA, Preisser JS, Gesler WM, Powers JM. Access to transportation and health care utilization in a rural region. *The Journal of Rural Health*. 2005;21(1):31-38.
44. Levesque J-F, Harris MF, Russell G. Patient-centred access to health care: conceptualising access at the interface of health systems and populations. *International journal for equity in health*. 2013;12(1):18.
45. Guidry J, Aday L, Zhang D, Winn R. Transportation as a barrier to cancer treatment. *Cancer practice*. 1997;5(6):361-366.
46. Silver D, Blustein J, Weitzman BC. Transportation to clinic: findings from a pilot clinic-based survey of low-income suburbanites. *Journal of immigrant and minority health*. 2012;14(2):350-355.
47. Rask KJ, Williams MV, Parker RM, McNagny SE. Obstacles predicting lack of a regular provider and delays in seeking care for patients at an urban public hospital. *JAMA*. 1994;271(24):1931-1933.
48. Fields BE, Bigbee JL, Bell JF. Associations of Provider-to-Population Ratios and Population Health by County-Level Rurality. *The Journal of Rural Health*. 2016;32(3):235-244.
49. Chan L, Hart LG, Goodman DC. Geographic access to health care for rural Medicare beneficiaries. *The Journal of Rural Health*. 2006;22(2):140-146.
50. Bell N, Kidanie T, Cai B, Krause JS. Geographic variation in outpatient health care service utilization after spinal cord injury. *Archives of physical medicine and rehabilitation*. 2017;98(2):341-346.
51. Goode AP, Freburger JK, Carey TS. The influence of rural versus urban residence on utilization and receipt of care for chronic low back pain. *The Journal of Rural Health*. 2013;29(2):205-214.

52. Hart LG, Salsberg E, Phillips DM, Lishner DM. Rural health care providers in the United States. *The Journal of Rural Health*. 2002;18(5):211-231.
53. Iversen MD, Chhabriya RK, Shadick N. Predictors of the use of physical therapy services among patients with rheumatoid arthritis. *Physical therapy*. 2011;91(1):65-76.
54. Freburger JK, Holmes GM. Physical therapy use by community-based older people. *Physical therapy*. 2005;85(1):19-33.
55. Feyer A-M, Herbison P, Williamson AM, et al. The role of physical and psychological factors in occupational low back pain: a prospective cohort study. *Occupational and environmental medicine*. 2000;57(2):116-120.
56. Waters TR, Dick RB, Davis-Barkley J, Krieg EF. A cross-sectional study of risk factors for musculoskeletal symptoms in the workplace using data from the General Social Survey (GSS). *Journal of Occupational and Environmental Medicine*. 2007;49(2):172-184.
57. Sterud T, Tynes T. Work-related psychosocial and mechanical risk factors for low back pain: a 3-year follow-up study of the general working population in Norway. *Occup Environ Med*. 2013;70(5):296-302.
58. Rundell SD, Sherman KJ, Heagerty PJ, Mock C, Jarvik JG. Patient-reported outcomes associated with use of physical therapist services by older adults with a new visit for back pain. *Physical therapy*. 2015;95(2):190-201.
59. Webster BS, Verma S, Willetts J, Hopcia K, Wasiak R. Association of disability duration with physical therapy services provided after meniscal surgery in a workers' compensation population. *Archives of physical medicine and rehabilitation*. 2011;92(10):1542-1551.
60. Fritz JM, Cleland JA, Speckman M, Brennan GP, Hunter SJ. Physical therapy for acute low back pain: associations with subsequent healthcare costs. *Spine*. 2008;33(16):1800-1805.
61. Childs JD, Fritz JM, Wu SS, et al. Implications of early and guideline adherent physical therapy for low back pain on utilization and costs. *BMC health services research*. 2015;15(1):150.
62. Fritz JM, Cleland JA, Brennan GP. Does adherence to the guideline recommendation for active treatments improve the quality of care for patients with acute low back pain delivered by physical therapists? *Medical care*. 2007;45(10):973-980.
63. Fritz JM, Childs JD, Wainner RS, Flynn TW. Primary care referral of patients with low back pain to physical therapy: impact on future health care utilization and costs. *Spine*. 2012;37(25):2114-2121.
64. Fritz JM, Magel JS, McFadden M, et al. Early physical therapy vs usual care in patients with recent-onset low back pain: a randomized clinical trial. *Jama*. 2015;314(14):1459-1467.
65. Karvelas DA, Rundell SD, Friedly JL, et al. Subsequent health-care utilization associated with early physical therapy for new episodes of low back pain in older adults. *The Spine Journal*. 2017;17(3):380-389.
66. Rundell SD, Gellhorn AC, Comstock BA, Heagerty PJ, Friedly JL, Jarvik JG. Clinical outcomes of early and later physical therapist services for older adults with back pain. *The Spine Journal*. 2015;15(8):1744-1755.
67. Gellhorn AC, Chan L, Martin B, Friedly J. Management patterns in acute low back pain: the role of physical therapy. *Spine*. 2012;37(9):775.
68. Delitto A. Low Back Pain. *J Orthop Sports Phys Ther*. 2012;42(4):A1-A57. doi:10.2519
69. Bekkering G, Hendriks H, Koes B, et al. Dutch physiotherapy guidelines for low back pain. *Physiotherapy*. 2003;89(2):82-96.

70. Frogner BK, Harwood K, Andrilla CHA, Schwartz M, Pines JM. Physical Therapy as the First Point of Care to Treat Low Back Pain: An Instrumental Variables Approach to Estimate Impact on Opioid Prescription, Health Care Utilization, and Costs. *Health services research*. 2018;
71. Shmagel A, Foley R, Ibrahim H. Epidemiology of chronic low back pain in US adults: data from the 2009–2010 National Health and Nutrition Examination Survey. *Arthritis care & research*. 2016;68(11):1688-1694.
72. Martin BI, Turner JA, Mirza SK, Lee MJ, Comstock BA, Deyo RA. Trends in health care expenditures, utilization, and health status among US adults with spine problems, 1997–2006. *Spine*. 2009;34(19):2077-2084.
73. Turner JA, Franklin G, Fulton-Kehoe D, et al. Prediction of chronic disability in work-related musculoskeletal disorders: a prospective, population-based study. *BMC Musculoskeletal Disorders*. 2004;5(1):14.
74. Andersen RM. Revisiting the behavioral model and access to medical care: does it matter? *Journal of health and social behavior*. 1995:1-10.
75. Penchansky R, Thomas JW. The concept of access: definition and relationship to consumer satisfaction. *Medical care*. 1981:127-140.
76. Aday LA, Andersen R. A framework for the study of access to medical care. *Health services research*. 1974;9(3):208.
77. Salkever DS. Accessibility and the demand for preventive care. *Social Science & Medicine (1967)*. 1976;10(9-10):469-475.
78. Ferguson SA, Merryweather A, Thiese MS, et al. Prevalence of low back pain, seeking medical care, and lost time due to low back pain among manual material handling workers in the United States. *BMC Musculoskelet Disord*. May 22 2019;20(1):243. doi:10.1186/s12891-019-2594-0
79. Hoy D, March L, Brooks P, et al. The global burden of low back pain: estimates from the Global Burden of Disease 2010 study. *Ann Rheum Dis*. Jun 2014;73(6):968-74. doi:10.1136/annrheumdis-2013-204428
80. Luckhaupt SE, Dahlhamer JM, Gonzales GT, et al. Prevalence, Recognition of Work-Relatedness, and Effect on Work of Low Back Pain Among U.S. Workers. *Ann Intern Med*. Aug 20 2019;171(4):301-304. doi:10.7326/M18-3602
81. da C Menezes Costa L, Maher CG, Hancock MJ, McAuley JH, Herbert RD, Costa LO. The prognosis of acute and persistent low-back pain: a meta-analysis. *CMAJ*. Aug 07 2012;184(11):E613-24. doi:10.1503/cmaj.111271
82. Negrusa S, Thumula V, Lea RD, Liu T-C. Patient-Reported Functional Outcomes after Low Back Pain - A Comparison of Workers' Compensation and Other Payors. Februrary 2023. p. WC-23-17.
83. Qaseem A, Wilt TJ, McLean RM, Forciea MA, Physicians CGCotACo. Noninvasive Treatments for Acute, Subacute, and Chronic Low Back Pain: A Clinical Practice Guideline From the American College of Physicians. *Ann Intern Med*. Apr 2017;166(7):514-530. doi:10.7326/M16-2367
84. Chin B, Rundell SD, Sears JM, Fulton-Kehoe D, Spector JT, Franklin GM. Intensity of physical therapy services: Association with work and health outcomes in injured workers with back pain in Washington State. *Am J Ind Med*. Jan 2023;66(1):94-106. doi:10.1002/ajim.23440

85. Wang D, Mueller K, Lea R. Outcomes Associated with Manual Therapy for Workers with Non-Chronic Low Back Pain. September 2021. p. WC-21-23.
86. Turner JA, Franklin G, Fulton-Kehoe D, et al. ISSLS prize winner: early predictors of chronic work disability: a prospective, population-based study of workers with back injuries. *Spine*. 2008;33(25):2809-2818.
87. USDA. *Economic Research Service (ERS) Urban Influence Codes. Documentation*. https://www.ers.usda.gov/data-products/urban-influence-codes/documentation/
88. ESRI. ArcGIS desktop: release 10.5.1. *Redlands, CA*. 2017;
89. Statacorp. *Stata Statistical Software: Release 15* . College Station, TX:: StataCorp LLC; 2017.
90. Schafer JL. Multiple imputation: a primer. *Stat Methods Med Res*. Mar 1999;8(1):3-15. doi:10.1177/096228029900800102
91. Bennett DA. How can I deal with missing data in my study? *Aust N Z J Public Health*. Oct 2001;25(5):464-9.
92. Murray CJ, Lopez AD. Measuring the global burden of disease. *N Engl J Med*. Aug 2013;369(5):448-57. doi:10.1056/NEJMra1201534
93. Rubin DI. Epidemiology and risk factors for spine pain. *Neurol Clin*. May 2007;25(2):353-71. doi:10.1016/j.ncl.2007.01.004
94. Chou R, Shekelle P. Will this patient develop persistent disabling low back pain? *JAMA*. Apr 07 2010;303(13):1295-302. doi:10.1001/jama.2010.344
95. Koes BW, van Tulder MW, Ostelo R, Burton AK, Waddell G. Clinical guidelines for the management of low back pain in primary care: an international comparison. *Spine*. 2001;26(22):2504-2513.
96. Briggs MS, Ulses C, VanEtten L, et al. Predictive Factors for Patients' Failure to Show for Initial Outpatient Physical Therapist Evaluation. *Phys Ther*. May 2021;101(5)doi:10.1093/ptj/pzab047
97. Iversen MD, Fossel AH, Daltroy LH. Rheumatologist–patient communication about exercise and physical therapy in the management of rheumatoid arthritis. *Arthritis Care & Research*. 1999;12(3):180-192.
98. Côté P, Baldwin ML, Johnson WG. Early patterns of care for occupational back pain. *Spine (Phila Pa 1976)*. Mar 01 2005;30(5):581-7. doi:10.1097/01.brs.0000154613.17511.dd
99. Blanchette MA, Rivard M, Dionne CE, Hogg-Johnson S, Steenstra I. Workers' characteristics associated with the type of healthcare provider first seen for occupational back pain. *BMC Musculoskelet Disord*. 10 18 2016;17(1):428. doi:10.1186/s12891-016-1298-y
100. National Institute for Occupational Safety and Health (NIOSH). National Occupational Research Agenda (NORA). Accessed Feb 18, 2021. Retrieved from https://www.cdc.gov/nora/sectorapproach.html
101. Stover BD, Turner JA, Franklin G, et al. Factors associated with early opioid prescription among workers with low back injuries. *The Journal of Pain*. 2006;7(10):718-725.
102. Molano SM, Burdorf A, Elders LA. Factors associated with medical care-seeking due to low-back pain in scaffolders. *Am J Ind Med*. Sep 2001;40(3):275-81. doi:10.1002/ajim.1099
103. Hayden JA, Dunn KM, van der Windt DA, Shaw WS. What is the prognosis of back pain? *Best Pract Res Clin Rheumatol*. Apr 2010;24(2):167-79. doi:10.1016/j.berh.2009.12.005

104. Hill JC, Fritz JM. Psychosocial influences on low back pain, disability, and response to treatment. *Phys Ther*. May 2011;91(5):712-21. doi:10.2522/ptj.20100280
105. Hill JC, Whitehurst DG, Lewis M, et al. Comparison of stratified primary care management for low back pain with current best practice (STarT Back): a randomised controlled trial. *The Lancet*. 2011;378(9802):1560-1571.
106. Archer KR, Coronado RA, Wegener ST. The role of psychologically informed physical therapy for musculoskeletal pain. *Current Physical Medicine and Rehabilitation Reports*. 2018;6(1):15-25.
107. Smuck M, Kao MC, Brar N, Martinez-Ith A, Choi J, Tomkins-Lane CC. Does physical activity influence the relationship between low back pain and obesity? *Spine J*. Feb 01 2014;14(2):209-16. doi:10.1016/j.spinee.2013.11.010
108. Dagenais S, Caro J, Haldeman S. A systematic review of low back pain cost of illness studies in the United States and internationally. *Spine J*. 2008 Jan-Feb 2008;8(1):8-20. doi:10.1016/j.spinee.2007.10.005
109. Ma VY, Chan L, Carruthers KJ. Incidence, prevalence, costs, and impact on disability of common conditions requiring rehabilitation in the United States: stroke, spinal cord injury, traumatic brain injury, multiple sclerosis, osteoarthritis, rheumatoid arthritis, limb loss, and back pain. *Arch Phys Med Rehabil*. May 2014;95(5):986-995.e1. doi:10.1016/j.apmr.2013.10.032
110. Hashemi L, Webster BS, Clancy EA. Trends in disability duration and cost of workers' compensation low back pain claims (1988-1996). *J Occup Environ Med*. Dec 1998;40(12):1110-9. doi:10.1097/00043764-199812000-00011
111. George SZ, Fritz JM, Silfies SP, et al. Interventions for the Management of Acute and Chronic Low Back Pain: Revision 2021. *J Orthop Sports Phys Ther*. Nov 2021;51(11):CPG1-CPG60. doi:10.2519/jospt.2021.0304
112. Von Korff M, Ormel J, Keefe FJ, Dworkin SF. Grading the severity of chronic pain. *Pain*. Aug 1992;50(2):133-149. doi:10.1016/0304-3959(92)90154-4
113. Roland M, Morris R. A study of the natural history of back pain. Part I: development of a reliable and sensitive measure of disability in low-back pain. *Spine (Phila Pa 1976)*. Mar 1983;8(2):141-4. doi:10.1097/00007632-198303000-00004
114. Rutten GM, Degen S, Hendriks EJ, Braspenning JC, Harting J, Oostendorp RA. Adherence to clinical practice guidelines for low back pain in physical therapy: do patients benefit? *Physical therapy*. 2016;90(8):1111-1122.
115. Hayden JA, Ellis J, Ogilvie R, Malmivaara A, van Tulder MW. Exercise therapy for chronic low back pain. *Cochrane Database Syst Rev*. 09 28 2021;9:CD009790. doi:10.1002/14651858.CD009790.pub2
116. Jordan K, Dunn KM, Lewis M, Croft P. A minimal clinically important difference was derived for the Roland-Morris Disability Questionnaire for low back pain. *J Clin Epidemiol*. Jan 2006;59(1):45-52. doi:10.1016/j.jclinepi.2005.03.018
117. Ostelo RW, Deyo RA, Stratford P, et al. Interpreting change scores for pain and functional status in low back pain: towards international consensus regarding minimal important change. *Spine (Phila Pa 1976)*. Jan 01 2008;33(1):90-4. doi:10.1097/BRS.0b013e31815e3a10
118. Cancelliere C, Donovan J, Stochkendahl MJ, et al. Factors affecting return to work after injury or illness: best evidence synthesis of systematic reviews. *Chiropractic & manual therapies*. 2016;24(1):1-23.

119. Ostelo R, van Tulder MW, Vlaeyen J, Linton SJ, Morley S, Assendelft W. Behavioural treatment for chronic low-back pain. *Cochrane Database Syst Rev*. 2005;1(1)
120. Ho EK, Chen L, Simic M, et al. Psychological interventions for chronic, non-specific low back pain: systematic review with network meta-analysis. *BMJ*. 03 30 2022;376:e067718. doi:10.1136/bmj-2021-067718
121. Industries WSDoLa. *Intro to L&I's Workers' Comp Insurance.* https://www.lni.wa.gov/ClaimsIns/Insurance/Learn/Intro/Default.asp
122. Bonauto D, Adams D. SOII Undercount Research: Washington SOII-WC Record Linkage, 2000-2011. 2014;
123. Coughlin SS. Recall bias in epidemiologic studies. *Journal of clinical epidemiology*. 1990;43(1):87-91.

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## APPENDICES

Appendix A. Back-Injured Worker-to-PT Provider Ratios

### Overview

In Chapter 2, the primary study aim was to examine the variation in access to PT services among workers with back pain by rural and urban areas. We examined access to PT services in two ways: 1) travel distance to a PT provider and 2) timing to the first PT provider visit by rural and urban area. In addition to these two access to PT measures, we examined the association between a third measure of PT access, back-injured worker-to-PT provider ratio, by rural and urban area in each of WA's 39 counties. In this section of the Appendix, I present some background information, methodology, and highlight the findings for this sub-aim.

### Background

Workers residing in rural areas encounter substantial obstacles in accessing PT services in contrast to their urban counterparts. Rural areas frequently experience an unmet need for healthcare providers, facilities, and specialized care for conditions like LBP.[1-3] These rural workers face extended travel distances, longer commutes, and increased transportation expenses when seeking health care services, including PT services.[1-3] Administrative challenges, such as delayed PT referrals, inadequate patient care coordination, scheduling issues, and prolonged appointment wait times, further jeopardize timely access to PT care.[1,4,5] Additionally, transportation limitations, such as the absence of vehicles, lack of public transportation, and limited proximity to PT clinics pose significant challenges for those in need of PT services.[1-3,6,7]

Compared to urban areas, rural areas are prone to have fewer medical providers and specialty care services[8] and studies have found that when comparing supply of providers, there was a higher prevalence of physician assistants and nurse practitioners working in rural areas compared to primary care physicians and medical specialists.[9] To highlight the shortage in provider supply, rural areas had smaller provider-to-population ratios, which were found to be associated with poorer health outcomes compared to their urban counterparts.[10] Furthermore, there appears to be a relationship between provider supply and health outcomes. In a study of registered nurses (RNs) and primary care physicians (PCPs), researchers found that areas with the highest RN-to-population ratios and PCP-to-population ratios were associated with fewer years of potential life lost, lower rates of poor or fair health, fewer teen births, and greater mammography screening in patients receiving medical care compared to areas with the lowest provider-to-populations ratios.[10] This finding was most significant in the smallest rural counties compared to larger counties and showcases the impact that the limited supply of clinical providers has on the health outcomes of the population it serves primarily in rural areas .

## Methods

*Study design, study population, and defining back-injured worker-to-PT provider ratio*

Consistent with the methods section from Chapter 2, we identified a retrospective cohort of workers with a back injury using WC claims data from the WA L&I State Fund from January 1, 2016 through December 31, 2019. The L&I State Fund consists of administrative claims, medical billing, and provider data that include worker-specific and provider-level information such as demographic characteristics, medical diagnoses, and CPT codes and information about the location of the worker's home residence and the provider's business address. For our third access to PT measure, back-injured workers-to-PT provider ratios, we defined this access measure as the total number of back injured workers divided by the total number of PT providers that billed for PT services within each of WA's 39 counties during this study period. The total number of injured workers was determined using our back pain case definition presented in the methods section of Chapter 2). The total number of PT providers was counted using available PT provider identification numbers. To be considered an PT provider, we identified claims that had a PT-specific CPT codes (Appendix C) that were billed by a licensed PT provider or a facility (e.g., hospital, clinic) providing PT services.

*Categorizing Rural and Urban Area*

The 2013 National Center for Health Statistics (NCHS) Urban-Rural classification scheme for counties was used to categorize the 39 WA counties across the urban-rural continuum when we examined the distribution of back-injured workers-to-PT provider ratios by county.[11] The NCHS Urban-Rural classification for counties scheme consists of a six-level urban-rural classification scheme for US counties (four representing metropolitan areas and two representing non-metropolitan areas). These six urban-rural levels include the following categories (population by ascending order of rurality): 1) Large central metro, 2) Large fringe metro, 3) Medium metro, 4) Small metro, 5) Micropolitan, 6) Non-Core.[11] A visual map (Figure A.1) of back-injured worker-to-PT provider ratio was created using Tableau Desktop, version 2021.4.5 software.[12]

## FINDINGS

*Injured worker-to-PT provider ratio*

Figure A.1 shows the distribution of back-injured worker-to-PT provider ratios for counties in WA, using the six-level NCHS Urban–Rural Classification Scheme for Counties.[11] In the only large central metro area in WA, King County, we found a back-injured worker-to-PT provider ratio of 1.5, which indicates that for every 3 injured workers with back pain, there were at least 2 available PT providers who could actively bill for PT procedures for a WA L&I claim in that county. Back-injured workers-to-PT provider ratios less than 6.0 were predominantly located in counties along the Puget Sound, in the large fringe metros (Snohomish, Pierce, Clark, and Skamania), and in most medium metros including Spokane county and its neighboring counties (Figure A.2). Most counties that had highest back-injured worker-to-PT provider ratios were primarily located in the central or more rural areas of the state, where availability of PT providers appear to be more scarce (Figure A.2). Douglas County, followed by Garfield, Klickitat, Grant, and Franklin Counties, had the highest IW-PT provider ratio with a range between 11.2 for Franklin County to 21.4 in Douglas County (Figure A.2). Asotin county, a small metro, located in Southeastern WA had the smallest back-injured worker-to-PT provider ratio in the entire state of 0.78, which indicates that there were fewer workers with back pain to available PT providers in that county. Upon further investigation, we found significantly fewer total number of injured workers (n= 40) with back pain residing in Asotin county compared to the average total number of injured workers (n=831) for other small metropolitan counties. The total number of licensed PT providers working in Asotin County was also much lower (n=50) compared to the average for other small metropolitan areas (n=187); however, higher than the number of injured workers with back pain in that county during this study period.

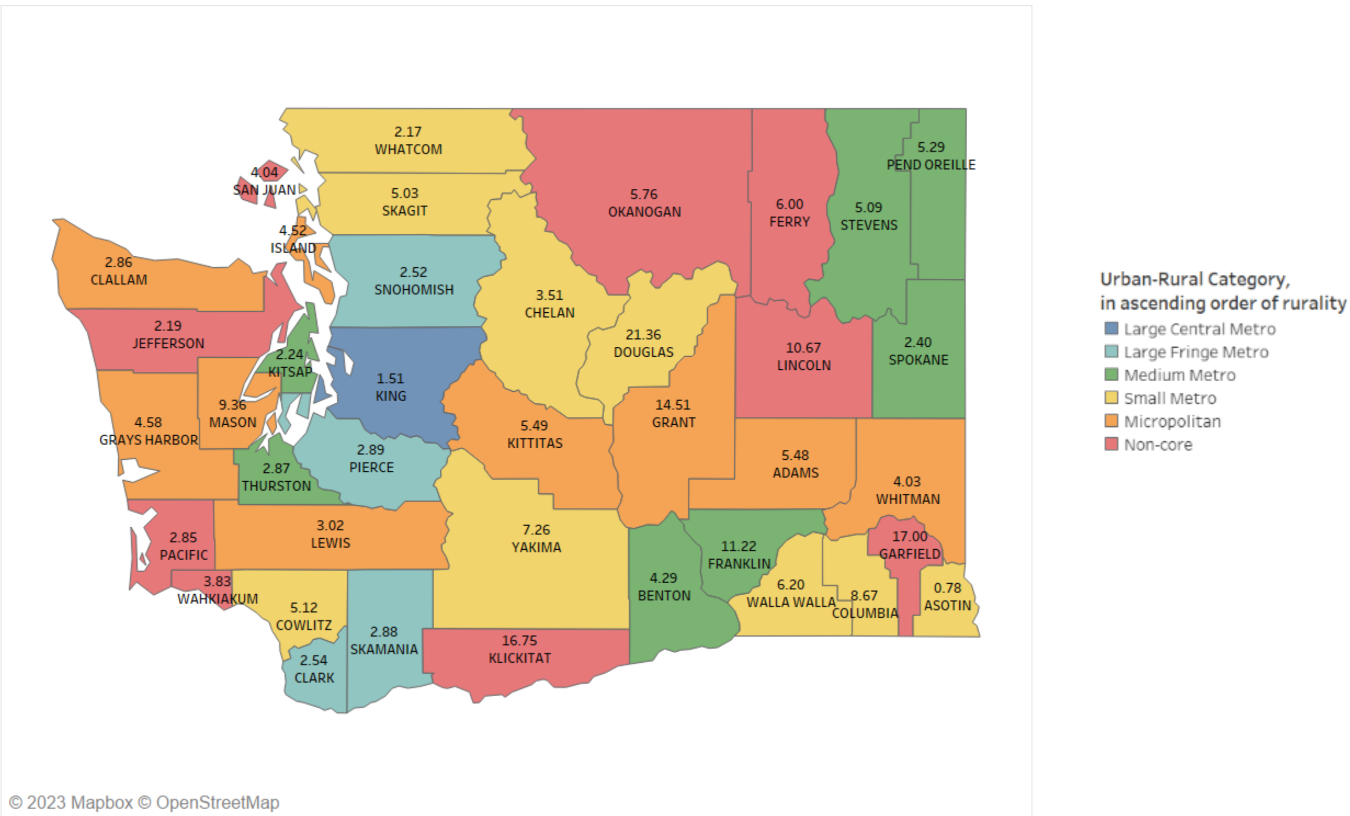


Figure A.1 County Distribution of Back-Injured Worker-to-Physical Therapy Provider Ratios Using the NCHS Urban-Rural Classification Scheme for Counties in Washington State

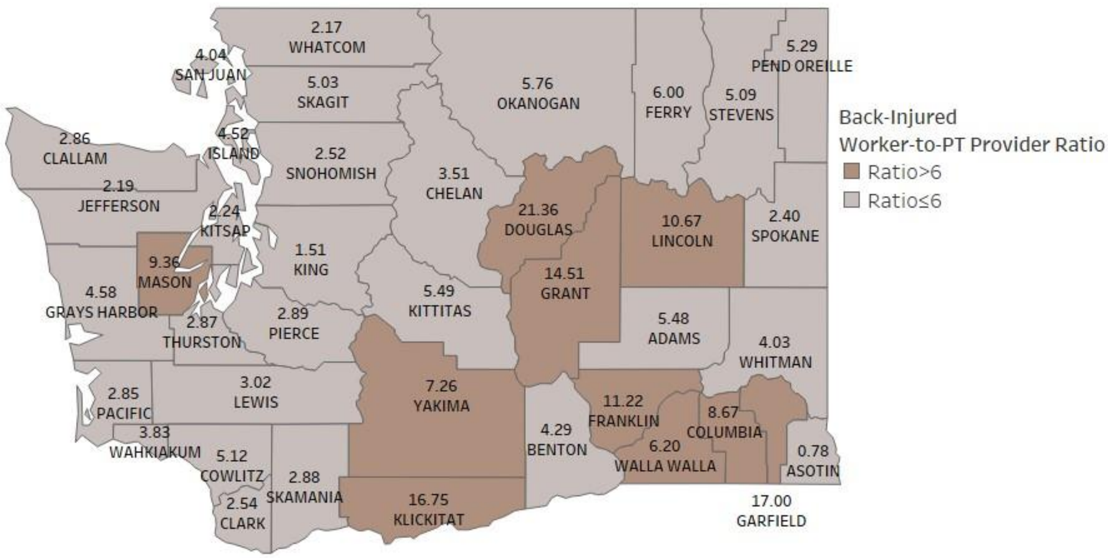


Figure A.2 County Distribution of Back-Injured Worker-to-Physical Therapy Provider Ratios in Washington State: A ≤6 or >6 ratio Comparison

## DISCUSSION

The primary objective of this sub-aim was to explore the distribution of back-injured worker-to-PT provider ratios by rural and urban areas in each of WA's 39 counties for WC claims filed between 2016 to 2019. Our general conclusion is that workers residing in the central part of WA and in more rural areas had a higher back-injured worker-to-PT provider ratios compared to workers residing in largely more urban areas.

Our findings are consistent with the literature, which show challenges in accessing health care services commonly faced by workers residing in mostly rural areas.[1-4] One primary challenge for rural residents is the scarcity of PT clinics and PT providers who work in these communities.[4] Rural areas often have a limited healthcare infrastructure, with fewer clinics and health care providers compared to urban areas.[4] Based on our back-injured worker-to-PT provider ratio findings, we found that urban areas, where population density is higher and health care resources are more abundant, had generally more available PT providers. Previous research also supports this finding. In a study that examined the RN-to-population and PCP-to-population ratios, they found that rural areas had lower RN-to-population and PCP-to-population ratios compared to urban areas.[13] In our study, we found that the highest back-injured worker-to-PT provider ratios were generally located in small metro, micropolitan, and non-core urban-rural categories, with the largest ratio of 21.36 injured worker for every PT provider in Douglas County, WA. Conversely, we saw some of the smallest back-injured worker-to-PT provider ratios in some of the most densely populated WA regions, which include the metropolitan areas near Seattle, WA, Spokane, WA, Portland, OR, and counties located near the Puget Sound. The low back-injured worker-to-PT provider ratio of 0.78 in Asotin County invites further investigation as this value differs from other counties with similar population sizes. One plausible explanation is that residents in Asotin County, a county bordering both Idaho and Oregon, may be seeking PT services in a larger town or city outside WA, where PT services may be more readily available (e.g., Lewiston, Idaho), which may reduce the total number of workers with back pain seeking PT services in that county and other bordering counties; therefore, making the ratio appear lower. Further research is needed to investigate whether injured workers residing in a county bordering other states seek PT or other health care services in other neighboring counties or states.

While it's important to compare the back-injured worker-to-PT provider ratios to a standardized numerical value, no studies exist to my knowledge that have estimated these ratios for the back-injured working population. Therefore, we were unable to provide a comparable value to benchmark whether these ratios are considered an undersupply or oversupply of PT services.

Another challenge for workers residing in rural areas are the clinical challenges that are exacerbated by the difficulties of recruitment and retention of licensed PT providers in rural areas.[14] Recruitment and retention may be due to factors such as lower salaried pay, lack of professional networks in the area, limited opportunities for continuing education, and infrastructure support for the PT provider.[14] As a result, the availability of PT services in rural areas may be limited, leading to reduced access of PT care for those who live in these areas. Furthermore, other factors such as health care affordability, patient accommodations, cultural and language barriers can further limit access to PT services in both rural and urban areas for lower socioeconomic and minority workers.[15-16] Although all of the workers in this study were covered through the WA L&I WC system, rural workers may face financial challenges due to lower incomes and higher out-of-pocket expenses, as well as limited insurance coverage options for health care services including PT services.[17] Despite the availability of PT services in more urban areas, affordability can still be a concern due to higher costs of living, greater demand with a larger population, and finding the right time to schedule a PT visit.

## CONCLUSION

In conclusion, we found that workers residing in most rural areas had higher back-injured worker-to-PT provider ratios compared to workers residing in urban areas. Variation in accessible and timely PT care remains a challenge, which can be influenced by various factors in both rural and urban areas, including availability of clinics and providers, transportation, affordability, insurance coverage, cultural and language barriers. Understanding these challenges is essential in addressing the disparities in access to care and improving the availability and utilization of PT services in both rural and urban communities. Further research and targeted interventions are needed to ensure that workers in all communities have equitable access to PT services for optimal health outcomes.

## REFERENCES


1. Syed ST, Gerber BS, Sharp LK. Traveling towards disease: transportation barriers to health care access. *Journal of community health*. 2013;38(5):976-993.
2. Probst JC, Laditka SB, Wang J-Y, Johnson AO. Effects of residence and race on burden of travel for care: cross sectional analysis of the 2001 US National Household Travel Survey. *BMC Health Services Research*. 2007;7(1):40.
3. Arcury TA, Preisser JS, Gesler WM, Powers JM. Access to transportation and health care utilization in a rural region. *The Journal of Rural Health*. 2005;21(1):31-38.
4. Rosenblatt RA, Hart LG. Physicians and rural America. *Western Journal of Medicine*. 2000;173(5):348.
5. Levesque J-F, Harris MF, Russell G. Patient-centred access to health care: conceptualising access at the interface of health systems and populations. *International journal for equity in health*. 2013;12(1):18.
6. Guidry J, Aday L, Zhang D, Winn R. Transportation as a barrier to cancer treatment. *Cancer practice*. 1997;5(6):361-366.
7. Silver D, Blustein J, Weitzman BC. Transportation to clinic: findings from a pilot clinic-based survey of low-income suburbanites. *Journal of immigrant and minority health*. 2012;14(2):350-355.
8. Rosenblatt RA, Hart LG. Physicians and rural America. *Western Journal of Medicine*. 2000;173(5):348.
9. National Center for Health Statistics N. State Variability in Supply of Office-based Primary Care Providers: United States, 2012
10. Fields BE, Bigbee JL, Bell JF. Associations of Provider-to-Population Ratios and Population Health by County-Level Rurality. *The Journal of Rural Health*. 2016;32(3):235-244.
11. Ingram DD, Franco SJ. *2013 NCHS urban-rural classification scheme for counties*. US Department of Health and Human Services, Centers for Disease Control and …; 2014.
12. Tableau. Tableau Desktop, Version 2021.4.5 Software. Accessed February, 2023. https://www.tableau.com/Products/Desktop
13. Fields BE, Bigbee JL, Bell JF. Associations of Provider-to-Population Ratios and Population Health by County-Level Rurality. *The Journal of Rural Health*. 2016;32(3):235-244.
14. Hartley D. Rural health disparities, population health, and rural culture. *American Journal of Public Health*. 2004;94(10):1675-1678.
15. Blumenthal SJ, Kagen J. The effects of socioeconomic status on health in rural and urban America. *Jama*. 2002;287(1):109-109.

16. Goode AP, Freburger JK, Carey TS. The influence of rural versus urban residence on utilization and receipt of care for chronic low back pain. *The Journal of Rural Health*. 2013;29(2):205-214.
17. Hartley D, Quam L, Lurie N. Urban and rural differences in health insurance and access to care. *The Journal of Rural Health*. 1994;10(2):98-108.

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Appendix B. BLS OIICS Body Part Codes version 1.01

| OIICS Body Part and Nature of Injury Codes Inclusion Criteria | OIICS v1.01 (2007) | OIICS v2.01 (2012) |
|---|---|---|
| **Body Part (back area)** | | |
| Thoracic | 232 | 321 |
| Lumbar | 231 | 322 |
| Sacrum | 233 | 323 |
| Coccyx | 234 | 324 |
| Multiple trunk | 230, 238, 239 | 320, 328,329 |
| **Nature of Injury** | | |
| Traumatic injuries to muscles tendons, ligaments, joints, etc. | | |
| Traumatic injuries to muscles, tendons, ligaments, joints, etc., unspecified | 020 | 120 |
| Sprains, strains, tears | 021 | 1230, 1231, 1232, 1233, 1238 |
| Injuries to muscles, tendons, ligaments, joints, etc. | 029 | 129 |
| Multiple traumatic injuries and disorders | | |
| Sprains and bruises | 082 | 1820, 1821, 1822, 1829 |
| Non-specified injuries and disorders | | |
| Back pain, hurt back including inflammation | 0972 | 1972, 1973, 1974 |
| Multiple non-specified injuries, such as pain in back and arm | 0978 | 1978 |
| Dorsopathies | | |
| Dorsopathies, unspecified | 1720 | 2720 |
| Sciatica | 1721 | 2721 |
| Lumbago | 1722 | 2722 |
| Disc disorders, except dislocation | 1723 | 2723 |
| Spondylitis and spondylosis of the spine, other nontraumatic backaches, and other nontraumatic back spasms | 1729 | 2729 |

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Appendix C. Exclusion criteria for back pain using ICD-9-CM and ICD-10-CM codes

| Exclusion Criteria | ICD-9-CM | ICD-10-CM |
|---|---|---|
| **Inflammatory spondyloarthopathies** | **720.0-720.9** | **M45.90, M46.00, M46.1, M46.8, M46.9** |
| Ankylosing spondylitis | 720.0 | M45.90 |
| Spinal enthesopathy | 720.1 | M46.00 |
| Sacroiliitis, not elsewhere classified | 720.2 | M46.10 |
| Other inflammatory spondylopathies | 720.8 | M46.8 |
| Unspecified inflammatory spondylopathy | 720.9 | M46.9 |
| Osteoporosis | 733.0-733.09 | M81.0, M81.8 |
| Osteoporosis, unspecified | 733.0 | M81.0 |
| Senile osteoporosis | 733.01 | M81.0 |
| Idiopathic osteoporosis | 733.02 | M81.8 |
| Disuse osteoporosis | 733.03 | M81.8 |
| Drug-induced osteporosis | 733.09 | M81.8 |
| **Spinal Infections** | **730.0-730.99** | **M86.1, M86.18, M86.19, M86.20, M86.28, M86.29, M86.3, M86.6, M86.68, M86.69, M86.9, M90.80, M90.88, M90.89** |
| Acute osteomyselitis | 730.0 | M86.10, M86.18, M86.19, M86.20, M86.28, M86.29 |
| Chronic osteomyelitis | 730.1 | M86.60, M86.68, M86.69 |
| Unspecified osteomyselitis | 730.2 | M86.9, M86.20 |
| Periostitis without mention of osteomyelitis | 730.3 | M86.9, M86.20 |
| Osteopathy resulting from poliomyelitis | 730.7 | M86.60, M86.68, M89.69 |
| Other infections involving bone in diseases classified elsewhere | 730.8 | M90.80, M90.88, M90.89 |
| Unspecified infection of the bone | 730.9 | M86.9, M86.30 |

| | | |
|---|---|---|
| **Developmental Spinal Deformities** | **737.30-737.43** | **M40.10, M40.50, M41.00, M41.20, M41.30, M41.40, M41.50, M41.80, M41.90, M43.8X9, M96.5** |
| Scoliosis and Kyphoscoliosis, idiopathic | 737.30 | M41.20 |
| Resolving infantile idiopathic scoliosis | 737.31 | M41.00 |
| Progressive infantile idiopathic scoliosis | 737.32 | M41.00 |
| Scoliosis due to radiation | 737.33 | M96.5 |
| Thoracogenic scoliosis | 737.34 | M41.30 |
| Other kyphoscoliosis and scoliosis | 737.39 | M41.80, M41.9 |
| Curvature of spine, unspecified, associated with other conditions | 737.40 | M43.8X9 |
| Kyphosis associated with other conditions | 737.41 | M40.10 |
| Lordosis associated with other conditions | 737.42 | M40.50 |
| Scoliosis associated with other conditions | 747.43 | M41.40, M41.50 |
| **Lumbar Spine Fracture** | **805-806.9** | |
| Closed fracture of cervical vertebra without mention of spinal cord injury | 805.0 | S12.9XXA |
| Open fracture of cervical vertebra without mention of spinal cord injury | 805.1 | S12.9XXA |
| Closed fracture of dorsal (thoracic) vertebra without mention of spinal cord injury | 805.2 | S22.009A |
| Open fracture of dorsal (thoracic) vertebra without mention of spinal cord injury | 805.3 | S22.009B |
| Closed fracture of lumbar vertebra without mention of spinal cord injury | 805.4 | S32.009A |
| Open fracture of lumbar vertebra without mention of spinal cord injury | 805.5 | S32.009B |
| Closed fracture of sacrum and coccyx without mention of spinal cord injury | 805.6 | S32.10XA, S32.2XXA |
| Open fracture of sacrum and coccyx without mention of spinal cord injury | 805.7 | S32.10XB, S32.2XXB |
| Closed fracture of unspecified vertebral column without mention of spinal cord injury | 805.8 | S12.9XXA, S22.009A, S32.009A, S32.10XA, S32.2XXA |
| Open fracture of unspecified vertebral column without mention of spinal cord injury | 805.9 | S12.9XXA, S22.009B, S32.009B, S32.10XB, S32.2XXB |

| | | |
|---|---|---|
| Closed fracture of cervical vertebra with spinal cord injury | 806.0 | S12.000A, S12.001A, S12.100A, S12.101A, S12.200A, S12.201A, S12.300A, S12.301A, S12.400A, S12.401A, S12.500A, S12.501A, S12.600A, S12.601A |
| C1-C4 level with unspecified spinal cord injury | 806.00 | S14.101A, S14.102A, S14.103A, , S14.104A |
| C1-C4 level with complete lesion of cord | 806.01 | S14.111A, S14.112A, S14.113A, S14.114A |
| C1-C4 level with anterior cord syndrome | 806.02 | S14.131A, S14.132A, S14.133A, S14.134A |
| C1-C4 level with central cord syndrome | 806.03 | S14.121A, S14.122A, S14.123A, S14.124A |
| C1-C4 level with other specified spinal cord injury | 806.04 | S14.151A, S14.152A, S14.153A, S14.154A |
| C5-C7 level with unspecified spinal cord injury | 806.05 | S14.105A, S14.106A, S14.107A |
| C5-C7 level with complete lesion of cord | 806.06 | S14.115A, S14.116A, S14.117A |
| C5-C7 level with anterior cord syndrome | 806.07 | S14.135A, S14.136A, S14.137A |
| C5-C7 level with central cord syndrome | 806.08 | S14.125A, S14.126A, S14.127A |
| C5-C7 level with other specified spinal cord injury | 806.09 | S14.155A, S14.156A, S14.157A |

| | | |
|---|---|---|
| Open fracture of cervical vertebra with spinal cord injury | 806.1 | S12.000B, S12.001B, S12.100B, S12.101B, S12.200B, S12.201B, S12.300B, S12.301B, S12.400B, S12.401B, S12.500B, S12.501B, S12.600B, S12.601B |
| C1-C4 level with unspecified spinal cord injury | 806.10 | S14.101A, S14.102A, S14.103A, S14.104A |
| C1-C4 level with complete lesion of cord | 806.11 | S14.111A, S14.112A, S14.113A, S14.114A |
| C1-C4 level with anterior cord syndrome | 806.12 | S14.131A, S14.132A, S14.133A, S14.134A |
| C1-C4 level with central cord syndrome | 806.13 | S14.121A, S14.122A, S14.123A, S14.124A |
| C1-C4 level with other specified spinal cord injury | 806.14 | S14.151A, S14.152A, S14.153A, S14.154A |
| C5-C7 level with unspecified spinal cord injury | 806.15 | S14.105A, S14.106A, S14.107A |
| C5-C7 level with complete lesion of cord | 806.16 | S14.115A, S14.116A, S14.117A |
| C5-C7 level with anterior cord syndrome | 806.17 | S14.135A, S14.136A, S14.137A |
| C5-C7 level with central cord syndrome | 806.18 | S14.125A, S14.126A, S14.127A |
| C5-C7 level with other specified spinal cord injury | 806.19 | S14.155A, S14.156A, S14.157A |
| Closed fracture of dorsal (thoracic) vertebra with spinal cord injury | 806.2 | S22.019A, S22.029A, S22.039A, S22.049A, S22.059A, S22.069A, S22.079A, S22.089A |

| | | |
|---|---|---|
| T1-T6 level with unspecified spinal cord injury | 806.20 | S24.101A, S24.102A |
| T1-T6 level with complete lesion of cord | 806.21 | S24.111A, S24.112A |
| T1-T6 level with anterior cord syndrome | 806.22 | S24.131A, S24.132A |
| T1-T6 level with central cord syndrome | 806.23 | S24.151A, S24.152A |
| T1-T6 level with other specified spinal cord injury | 806.24 | S24.151A, S24.152A |
| T7-T12 level with unspecified spinal cord injury | 806.25 | S24.103A, S24.104A |
| T7-T12 level with complete lesion of cord | 806.26 | S24.113A, S24.114A |
| T7-T12 level with anterior cord syndrome | 806.27 | S24.133A, S24.134A |
| T7-T12 level with central cord syndrome | 806.28 | S24.153A, S24.154A |
| T7-T12 level with other specified spinal cord injury | 806.29 | S24.153A, S24.154A |
| Open fracture of dorsal (thoracic) vertebra with spinal cord injury | 806.3 | S22.019B, S22.029B, S22.039B, S22.049B, S22.059B, S22.069B, S22.079B, S22.089B |
| T1-T6 level with unspecified spinal cord injury | 806.30 | S24.101A, S24.102A |
| T1-T6 level with complete lesion of cord | 806.31 | S24.111A, S24.112A |
| T1-T6 level with anterior cord syndrome | 806.32 | S24.131A, S24.132A |
| T1-T6 level with central cord syndrome | 806.33 | S24.151A, S24.152A |
| T1-T6 level with other specified spinal cord injury | 806.34 | S24.151A, S24.152A |
| T7-T12 level with unspecified spinal cord injury | 806.35 | S24.103A, S24.104A |
| T7-T12 level with complete lesion of cord | 806.36 | S24.113A, S24.114A |
| T7-T12 level with anterior cord syndrome | 806.37 | S24.133A, S24.134A |
| T7-T12 level with central cord syndrome | 806.38 | S24.153A, S24.154A |
| T7-T12 level with other specified spinal cord injury | 806.39 | S24.153A, S24.154A |

| | | |
|---|---|---|
| Closed fracture of lumbar vertebra with spinal cord injury | 806.4 | S32.009A, S34.109A, S34.119A, S34.129A, S32.019A, S34.101A, S34.111A, S34.131A, S32.029A, S34.102A, S34.112A, S34.122A, S32.039A, S34.103A, S34.113A, S34.123A, S32.049A, S34.104A, S34.114A, S34.124A, S32.059A, S34.105A, S34.115A, S34.125A |
| Open fracture of lumbar vertebra with spinal cord injury | 806.5 | S32.009B, S34.109A, S34.119A, S34.129A, S32.019B, S34.101A, S34.111A, S34.131A, S32.029B, S34.102A, S34.112A, S34.122A, S32.039B, S34.103A, S34.113A, S34.123A, S32.049B, S34.104A, S34.114A, S34.124A, S32.059B, S34.105A, S34.115A, S34.125A |
| Closed fracture of sacrum and coccyx with spinal cord injury | 806.6 | S32.10XA, S32.2XXA |
| with unspecified spinal cord injury | 806.60 | S34.139A |
| with complete cauda equina lesion | 806.61 | S34.3XXA |
| with other cauda equina injury | 806.62 | S34.3XXA |
| with other spinal cord injury | 806.69 | S34.131A, S34.132A |
| Open fracture of sacrum and coccyx with spinal cord injury | 806.7 | S32.10XB, S32.2XXB |
| with unspecified spinal cord injury | 806.70 | S34.139A |

| | | |
|---|---|---|
| with complete cauda equina lesion | 806.71 | S34.3XXA |
| with other cauda equina injury | 806.72 | S34.3XXA |
| with other spinal cord injury | 806.79 | S34.131A, S34.132A |
| Closed fracture of unspecified vertebral column with spinal cord injury | 806.8 | S12.9XXA, S14.109A, S22.009A, S24.109A, S32.009A, S34.109A, S32.10XA, S34.139A |
| Open fracture of unspecified vertebral column with spinal cord injury | 806.9 | S12.9XXA, S14.109A, S22.009B, S24.109A, S32.009B, S34.009B, S34.109A, S32.10XB, S34.139A |
| Tumors | 140-239.9 | C00-C96, C7A, C7B, D00-D49 |
| Intraspinal Abscess | 324.1 | G06.1 |
| Pregnancy-related diagnoses | 630-676.9 | O00-O09, O10-O16, O20-O48, O60-O77, O80-O82, O85-O92, O94-O9A |

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Appendix D. Procedure codes for physical therapy treatment categories

| Evaluation | Procedure codes | Description |
|---|---|---|
| 97001 – 97002 | CPT | Physical Therapy/Occupational Therapy evaluation codes |
| 97750 – 97755 | CPT | Physical performance codes |
| 1045M | L&I | Functional capacity evaluation |
| 1001M | L&I | Work hardening evaluation |
| 0389R | L&I | Job mod/pre-job accommodation consultation code |
| 8918H | L&I | Vehicle modification consultation |
| 8916H | L&I | Home modification consultation |
| Passive Interventions | | |
| 97010 – 97039 | CPT | Modality codes |
| E0745 – E0764 | HCPCS | Electrical stimulator codes |
| G0283 | HCPCS | Other electrical stimulus code |
| 97124 | CPT | Massage |
| 97597 – 97610 | CPT | Wound care |
| 97760 – 97762 | CPT | Orthotic/prosthetic management |
| 90901, 90911 | CPT | Biofeedback |
| 97799, 97139 | CPT | Unlisted procedures |
| 97039 | CPT | Unlisted modality |
| S8948 | HCPCS | Application of a modality, low-level laser |
| G0281 | HCPCS | Electrical Stimulation |
| Manual Therapy | | |
| 97140 | CPT | Manual Therapy |
| Active Interventions | | |
| 97110 – 97116 | CPT | Exercise codes |
| 97530 | CPT | Activity training |
| 97532 | CPT | Cognitive training |
| 97533 | CPT | Sensory integrative techniques |
| 95992 | CPT | Canalith repositioning (NMS re-ed) |
| 97545 – 97546 | CPT | Work Hardening/Conditioning codes |
| 97150 | CPT | Therapy (group) |
| 97532 – 97542 | CPT | Educational Interventions |
| 97535 | CPT | Self-care/home management training |
| 97537 | CPT | Community/work reintegration |
| 97542 | CPT | Wheelchair management (assessment, fitting, training) |

Abbreviations: CPT=Current Procedural Terminology; L&I=Washington State Department of Labor and Industries local procedural codes; HCPCS=and Healthcare Common Procedure Coding System

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